October 1945

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HON. E. P. CARVILLE

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PROF. L. O. STEWART

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Editorial:

Nation-Wide Mapping Program Should be Encouraged

EDITOR'S NOTE.—The following is an excerpt from an address by Governor E. P. Carville of Nevada (now U. S. Senator) at the Conference of State Governors, Mackinac Island, Michigan, July 3, 1945.

IT BEHOOVES us well to employ every possible means, and pursue every practical step to conserve and intelligently develop our seemingly boundless natural resources. If that be done, we, of the present generation, may reap the greatest benefits, and at the same time retain a heritage of permanency for our progeny. It is just common sense to do so.

I do not believe we have reached the danger point, as yet. We have not reached the stage of a "have not" nation, and we do not want to reach that stage. Currently we have ample resources to carry on for some years to come, but let us take heed.

In this light, it would be a constructive and progressive step for each state to effectuate a systematic method of checking, or taking stock, of its natural resources in all their categories. Let us survey the various fields and know definitely what supplies are visible, what are potential supplies, and what prospects we should have for newly found supplies.

One important step leading to the development of a program of conservation should be immediate action to overcome serious handicap caused by the lack of adequate maps of those regions containing our natural resources. Few people realize that the greater part of this country is inadequately mapped; and in the western states especially, vast areas have never been properly charted.

We should promote a program to complete the mapping of this country at an early date; for until this is done, it will not be possible for us to inventory and catalog our resources and plan for their efficient use. At present there is a great deal of activity in many of the states to develop a nation-wide mapping program, and this work should be encouraged.

E. P. CARVILLE

Some Principles Relating to Early Surveys of the Public Lands

By PROF. L. O. STEWART*

RECENT demand for surveys and maps for use in connection with projects such as Soil Conservation Service improvements, Rural Electrification Administration lines, Agricultural Adjustment Act allotments, and property line and corner descriptions with the aid of rectangular coordinates based upon geodetic control, as well as the progressive use and need for surveys and maps that give increasing accuracy and more detail, have again called attention to the significance of the original surveys of the public lands.

In this matter we have the anomalous situation that the most recent methods for making surveys of the public lands, the methods currently in use by the General Land Office, have only general and not specific value for anyone who seeks to retrace an original line or recover the site of an old monument. There is a two-fold reason for this: the surveying methods underwent progressive refinement as instruments and skills improved and land values increased, and early in the game the important principle was established that corners regularly set by the surveyor in the field are held to be the true corners, although later surveys may show that they were placed incorrectly.

Thus it becomes clear that a knowledge of the specific surveying methods that were used as set forth by the instructions governing the particular survey is a first prerequisite to a proper retracement of a given public land survey. Often times this includes a study of the copies of the original notes, where, it sometimes turns up, the surveyor introduced some variations in method that were not provided for specifically in the instructions that were given him by the Surveyor General when he set out on his contract to survey a designated tract of land.

This knowledge is useful also to the user of maps whenever the rectangular subdivision lines appear because it helps him to understand their deviations from regularity. Similarly, the property owner can profit from an understanding of the early surveying methods. But most important of all is that everyone, who has anything to do with operations that touch in any way the property line surveys, shall appreciate the importance of preserving boundaries and marks. It is for this reason that the author and others have written books and papers in which original records may be preserved. The author's book "Public Land Surveys—History,

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Instructions, Methods," and "Original Instructions Governing Public Land Surveys in Iowa" by the Iowa Engineering Society have served as the basis for this paper.

Early Public Land Legislation

It is important that we know the objectives of the early public land legislation and understand the point of view of the early legislators so that we may form a correct estimate of the surveys and the surveyors of that period. There were several factors that influenced the decisions and actions of that period. These were:

1. The urgent need of the Treasury for money. The treasuries of the colonies were empty and there were many unpaid bills, including those of the soldiers who were clamoring for back pay.
2. People were settling on unsurveyed land, which brought on unpleasant relationships between citizens and the Government.
3. Because of this rapid settlement surveys had to be pushed forward hastily. The method of surveying had to lend itself to rapid expansion into new country. Frequently, settlements occurred in isolated parcels of land which seemed to prevent the carrying on of a continuous and progressive scheme of surveys. Also, surveys were made only in territory belonging to the Government, additions to which were made from time to time by treaties with the Indians. Many of these acquisitions were irregular in shape and boundaries and, sometimes, left unceded land between old and new government holdings.
4. The contract system, which was in force during the period when the major portion of the public land surveys was made, tended to encourage deputies to use surveying methods that would produce results of the lowest acceptable precision.

The rectangular system of surveying was established by the Ordinance of May 20, 1785. The language of the act itself contained the description of the basic principles and provided for a "geographer, under whose direction the surveyors shall act, shall occasionally form such regulations for their conduct as he shall deem necessary."

The act provided:

> The surveyors, as they are respectively qualified, shall proceed to divide the said territory into townships six miles square, by lines running due north and south, and others crossing them at right angles, as near as may be, unless where the boundaries of the late Indian purchases may render the same impracticable, and then they shall depart from this rule no farther than such particular circumstances may require. And each surveyor shall be allowed and paid at the rate of two dollars for every mile in length he shall run, including the wages of chain carriers, markers, and every other expense attending the same. . . .
>
> The lines shall be measured with a chain; shall be plainly marked by chops on the trees, and exactly described on a plat; whereon, shall be noted by the surveyor, at their proper distances, all mines, salt springs, salt licks, and mill seats, that shall come to his knowledge; and all watercourses, mountains, and other

remarkable and permanent things over or near which such lines shall pass, and also the quality of the lands.

The plats of the townships, respectively, shall be marked by subdivisions into lots one mile square, or 640 acres, in the same direction as the external lines, and numbered from 1 to 36, always beginning the succeeding range of lots with the number next to that with which the preceding one concluded. And where, from the causes before mentioned, only a fractional part of a township shall be surveyed, the lots protracted thereon, shall bear the same numbers as if the township had been entire. And the surveyors, in running the external lines of the township, shall, at the interval of every mile, mark corners for the lots which are adjacent, always designating the same in a different manner from those of the townships.

It is noteworthy that no interior section lines were to be run in the field. Corners one mile apart were set on the township lines and the section lines were to be laid out on paper in the office. It was not until passage of the act of 1805 that the now well known practice of running section lines a mile apart and marking corners on the ground at half-mile intervals was established. This development marked a phase of the controversy between two groups of that period. One group was interested in the rapid disposal of the public lands in large blocks and was opposed to any surveying methods that would retard their sale. The other group wanted to get the land into the hands of the actual settler immediately. For him it was necessary that the land be identifiable on the ground in small units (this finally became a quarter section, 160 acres) and the property corners needed to be marked on the ground.

Early Surveys and Early Instructions

The early surveys were carried on without benefit of a set of instructions covering detailed procedures which would have made all operations uniform. The acts of Congress laid down general principles and specified that the geographer (later the Surveyor General) "shall occasionally form such regulations for their (the surveyors') conduct as he shall deem necessary." Thus, from the beginning of the surveys until the reorganization of the General Land Office in 1836 each surveyor general was an independent officer who applied the prescribed principles "according to the dictates of his own judgment." This seems to have caused little or no confusion at that time because there was no overlapping of districts and authority.

At first each surveyor general wrote the instructions in detail to each deputy for each surveying contract in his district. Many of these instructions were the same for all contracts so it was logical that a surveyor general should prepare a set of printed instructions, which would insure uniformity of surveying procedure on surveys under his direction and obviate the tedious writing of the repetitious sets of instructions.

The first of these sets of instructions, which is in any way complete, was drawn up by Edward Tiffin, who was Commissioner of the General Land Office from 1812 to 1814 and Surveyor General of the Lands north of the Ohio from 1815 to 1824. His instructions, which were issued about 1815, probably served as the model for various circulars and manuscripts of instructions which appeared later in 1828, 1834, 1837, and 1843.

The General Land Office was reorganized in 1836 and was given increased supervisory power over the work of the Surveyors General. It was evident that an *official* set of instructions would be desirable. So, in 1855, the General Land Office issued a "Manual of Surveying Instruction," to regulate the field operations of deputy surveyors. This manual was a revision of one that had been prepared for Oregon in 1851. Revisions of the 1855 manual have appeared from time to time as the need arose. These were issued by the General Land Office in 1871, 1881, 1890, 1894, 1902 and 1930. Each manual gives the regulations and instructions that were in effect at that time. Obsolete or superseded instructions were not repeated. This is a reason why it is essential that one have copies of the manual then in use as well as special instructions for the particular survey and its original survey notes when he sets out to retrace an old survey.

There have been many changes in the details of making surveys since the act of 1785. Some of these have dealt with increased precision; others have clarified inconsistencies. But throughout that period the basic pattern has remained unchanged. It is important enough to warrant brief summarization at this point.

The basic unit is the township six miles on a side with the boundary lines running north and south and east and west. Each township is divided into 36 sections, one mile on a side, by lines which run east and west, and by other lines which run parallel to the township's east boundary. Property corners are established on all lines at half-mile intervals. The position of each corner is designated by a suitable monument and is tied in to nearby natural or artificial objects. The lines between corners are marked at intervals by blazes on trees. Surveys may be started in a new tract without a "tie-in" with a previous survey.

The usefulness and wisdom of the plan have been established beyond doubt. Some modern critics may deplore the rigidity with which the rectangular system of surveying has determined street patterns in many cities. But they forget the advantages that accrued to innumerable property owners, particularly during the rush of the first settlement on the land. The parcels of land were equal (nearly) in size. In fact, throwing the excess and deficiency toward the north and west gave the maximum possible number of equal-area sections. The units were small enough to satisfy one settler. All corners were marked on the ground.

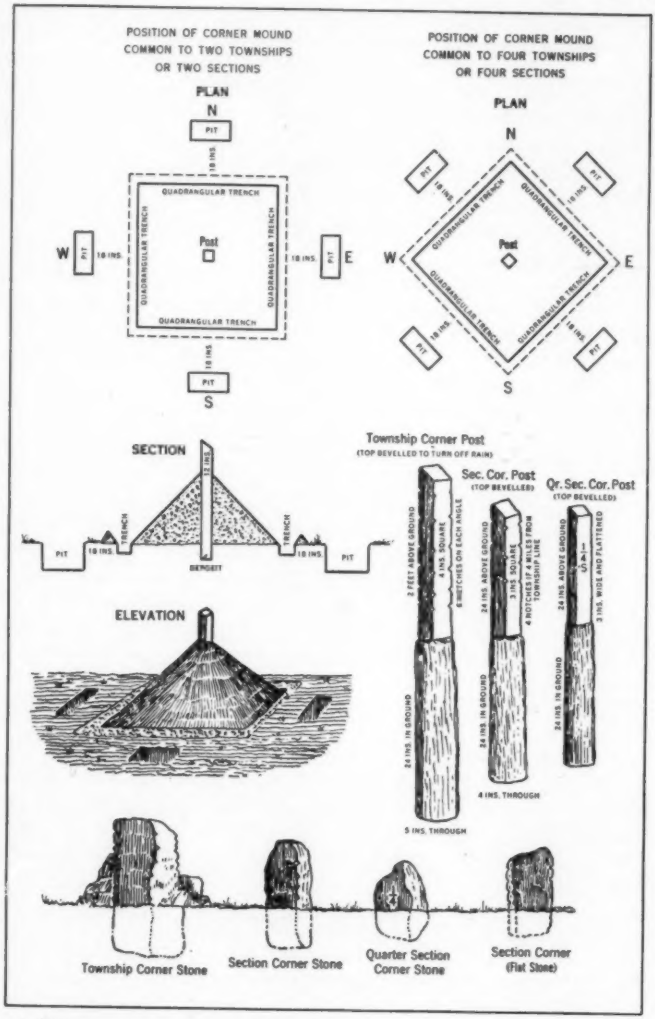


ILLUSTRATION OF MOUND, STAKE, AND STONE CORNER BOUNDARIES.
(Redrawn from General Land Office Manual of 1855.)

In wooded country the lines between corners were marked with blazes on the trees. All corners that were set by the surveyor in the field were held to be the true corners, although later surveys may show that they were placed incorrectly. The important fact is that the system worked. A settler could actually see and walk around the tract that he was buying; he knew what its area would be, within reasonable limits. It could be described accurately and simply by rectangular coordinates that were easily understood and that did not lend themselves to confusion or mistakes.

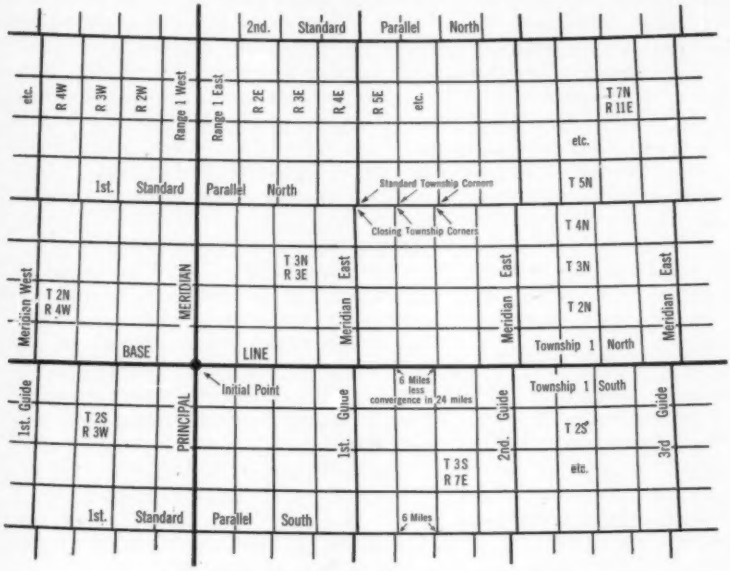
Method of Allowing for Convergence

There were some surveying perplexities that did need attention. Some of these such as variation and deviation of the magnetic compass, and wear of the links in the old-fashioned chain had to wait for better instruments. But the paradox that the townships were to be rectangular with the sides running in the cardinal directions was recognized as a difficulty from the beginning. It was apparent that the meridians would converge. The method used to limit the differences caused by this convergence was to introduce a parallel at frequent intervals above or below the baseline which was the principal east and west line. At this parallel, called a correction line, the range lines (six miles less convergence, apart), from below were ended and new range lines for the tract to the north of the correction line were started. It became the custom to make the south side of a township on the base and correction lines more than six miles in length. This extra length, which was about a chain during the early periods and became as much as three chains (in Iowa), was placed as an excess on the west half mile of section 31. Thus, townships immediately above a baseline or correction line were more than six miles wide and those just below such lines were less than six miles wide. On some line between the two extremes was a township that (theoretically) was six miles wide.

There seems to have been no standard practice on the spacing of correction lines prior to the manual of 1855. In Iowa they were spaced as far apart as ten townships (60 miles). In some districts there was some regularity at thirty mile intervals. The present well known method of dividing districts into "twenty-four mile tracts" was specified in the manual of 1855. According to that method standard parallels or correction lines are run at intervals of four townships (twenty-four miles) above the baseline, and five townships (thirty miles) below the baseline. Guide meridians twenty-four miles apart are run northward from the baseline to closing corners on the correction line. No excess of measurement is made on the baseline. The amount of convergence in twenty-four miles for various latitudes would be as follows: for latitude 40 degrees, 161 feet; for latitude 45 degrees, 192 feet; and for latitude 50 degrees, 228 feet.

Precision Requirements of Early Surveys

Early instructions had little to say about permissible errors and precision requirements. Land was cheap and surveying instruments and methods were crude. For example, an old Virginia law of 1779 provided for errors in field measurements by allowing five acres excess in each hundred acres. Tiffin, in his instructions of 1815, hints that there may



Subdivision of 24-Mile Blocks into Townships.

be limits to the errors. Sometime after 1815 the surveyors general began to include closure requirements in instructions to their deputies. A set of such instructions issued by the surveyor general at St. Louis in 1843 permits errors of five chains in closing a township, one chain in closing a section, and one and one-half chains per mile in closing meander lines. The latest manual, that for 1930, introduces the general requirement known as the error of closure and sets a limit "expressed by the fraction 1/452."

The need for a standard tape with which the field tapes would be compared was recognized in the act of May 18, 1796, in a section which said: "And the chain shall be adjusted to a standard to be kept for that

purpose." This injunction was included in the instructions of the Secretary of the Treasury to Putnam, the first Surveyor General in 1796. He was "to have a standard chain prepared by which to regulate the chains of the surveyors." Tiffin's instructions of 1815 say that "the chain must be adjusted to the standard chain in the office of the Surveyor General, and it will be of importance that both it and the compass be frequently examined in the field in order to determine any errors and irregularities which may arise from use of them." Likewise, in 1831, the Commissioner of the General Land Office wrote to the Surveyor General at Washington, saying that each deputy is required "to reserve one chain as a standard for field work, and by which he will adjust the one in active use, at least every other day, if not oftener. Each deputy will also provide himself with a good compass, with a nonius, or a theodolite (which latter in some respects is preferable, by reason of its peculiar adaptation to the taking of long sights) which will be compared with the standard in the Surveyor's office."

The records do not show how carefully these admonitions were followed. Statements about the kind of instrument, length of tape, etc., that are considered an essential part of a present-day set of notes, were omitted by the deputies on the early surveys. Few were as thorough as Wm. A. Burt who included these "remarks on the length of chain in winter weather." This was about 1836. He says: "Compared the measuring chain with the standard and adjusted it precisely thereto; warmed the measuring chain by the fire to a summer heat and compared it with the standard. A difference was found of about 4/10 of an inch. This was done on a cold day. And further it was found that my chainmen did not measure the same in deep snow that they did on clear ground."

After 1850, the deputies engaged on surveys in Iowa made occasional notes, such as "Adjusted chain to standard," or "Chain compared with standard and found $\frac{1}{2}$-inch too long, which corrected."

The first chains were by law, "chains containing two perches, of sixteen and one-half feet each, subdivided into twenty-five equal links." But the reckonings were kept in terms of four-pole chains at a very early date. So, later instructions (shortly before 1855) permitted the four-pole chains to be used on level and uniform ground. The manual of 1881 had an unusual stipulation about the length of chain. It stated that "township lines and subdivision lines will usually be measured by a two-pole chain of 33.03 feet in length, consisting of 50 links, and each link being 7 inches and ninety-two hundredths of an inch long. . . . The four-pole chain must be adjusted to lengths of 66.06 feet. The object in adding the six-hundredths of a foot to the 66 feet of a four-pole chain is to assure thereby that 66 feet will be set off upon the earth's surface without the application of a greater strain than about 20 pounds by the

chainman, thus, providing for loss by vertical curvature of the chain, and at the same time avoiding the uncertain results attending the application of strains taxing its elasticity."

Later manuals have provided for an assortment of standard steel chains or tapes and the most modern types of instruments, and the standards of precision have risen correspondingly. Furthermore, since 1910 all public land surveys have been made by engineers of the General Land Office, the old contract system having been discontinued in that year.

This general discussion of the early public land surveys will close with a plea to those engineers, surveyors, and anyone who has contact with and an interest in the early surveying records, urging them to see that the records are preserved in permanent form. The "oldtimers," the men who made a living by making public land surveys, are passing away. The succeeding generations have, usually, little understanding of the significance of the original records. Soon these will be cleaned out of the files in the statehouses where they are now gathering dust. When that happens they are gone forever because there are no copies in Washington. In each of the public states someone should prepare a book in which would be incorporated all of the original records and instructions that relate to the public land surveys, such as appear in the two books previously mentioned, and in "Ohio Land Subdivisions" by C. E. Sherman. That will require much searching and hard work but the permanent good will be shared by many future students and users of the original surveying records.

❦ ❦ ❦

Penalty for Removal of Survey Monuments

. . . Even as recently as the year 1798, an Act was passed in this country, providing for the placing of stone monuments to mark the boundaries of townships in Upper Canada and under that Act any person who destroyed or removed one of these monuments was made liable to penalty of death without the benefit of clergy.

. . . The Ancient Romans had the right idea in annually holding religious ceremonies and offering up sacrifices at the sites of their more important boundary stones. That kind of propaganda persuaded the public to regard a boundary stone not merely as a rock stuck in the ground but as a sacred and significant object to be looked upon with reverence and handled with care—which, of course, is the proper attitude.—J. H. Holloway in "Preservation and Restoration of Survey Monuments," *The Canadian Surveyor,* April 1945.

Topography on a Very Small Scale*

By R. H. FIELD

LAND surveyors are accustomed to think of length in chains or miles, of level differences in feet and contour intervals of 5, 10, 50, or more feet. Some of the practice of their art is, however, being applied every day by technicians to surfaces whose area must be expressed in square inches, where lengths are measured in inches or millimeters or where contour levels are 0.0001 inch apart or even closer.

Testing Surface Plates

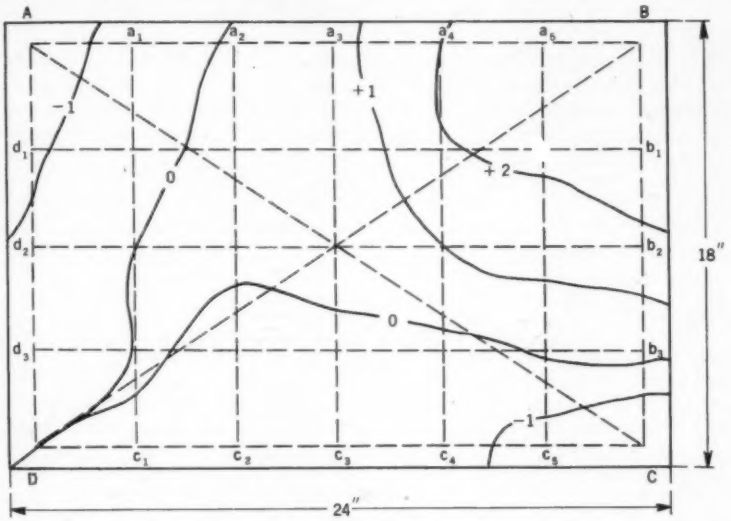
The surface plate is one of the fundamental reference tools of a mechanical workshop, and its departure from a true plane should be the minimum possible. In practice it is found that the errors of these plates can be easily established by what is essentially trigonometrical leveling. The prerequisite is an accurate, uniform, sensitive level vial. At Ottawa we use a German (Pessler) vial with a value of one division equal to 5 seconds of arc, as we have not been able to obtain British or American vials giving the same regularity and reproductibility of indications. There may be non-German vials on the market equally good, but we have yet to find them. The level vial is mounted, without unnecessary constraint, on a fixture having a lapped base about 8 inches long, permitting a pair of Johansson, or slip gauges, to be wrung to it at any desired distance apart.

First a network of straight lines is laid out on the surface plate, which is usually rectangular, as shown dotted in the figure. For the observations the plate is supported from a firm foundation on three small screw-jacks under the normal points of support, so that its working surface can be made nearly horizontal. The test is best carried out in a temperature-controlled room.

The two slip gauges are wrung on the lapped base of the level at a distance approximately equal to $Aa_1 = a_1a_2$, etc. Starting at A the two ends of the level bubble are read when the gauges are over A and a_1, then when over a_1 and a_2 and so on as far as B. The line of levels is then run in the reverse direction, from B to A, as a check. From the known angular value of one division on the vial and the length Aa, it is easy to compute the height of each of the stations a_1, a_2, etc., above or below A. A second line run from B to C with a new gauge spacing, Bb_1, establishes

* Reprinted through the courtesy of The Canadian Surveyor, April 1944.

the height of b_1, b_2, etc., to C in respect to B and therefore to A. A further line is run along the diagonal AC. Thus the heights of B and C are well established with respect to the datum A, and it is easy to continue on and establish the height of D.



The observed leveling lines are all adjusted proportionally to close at A, B, and C by simple methods analogous to traverse adjustment. Secondary lines of levels, run along the interior lines of the network, are in turn adjusted systematically to the heights of a_1, a_2; b_1, b_2, etc., already determined. Thus a simple calculation, easily laid out in tabular form, yields the elevation with respect to A of each station. Any three of these stations can be taken as defining a reference plane and the heights of the remaining stations above or below this plane can again be found by easy tabulation. In practice the reference plane is chosen to give the minimum departure from true flatness for the significant portion of the working surface. In the figure contour lines have been drawn to show the results of an actual test, the contour interval in this case being 0.0001 inch.

WHY NOT ENROLL ONE NEW MEMBER IN THE CONGRESS?

The American Congress on Surveying and Mapping*

By PROF. D. S. TROWBRIDGE†

IT IS a great privilege and pleasure to attend your Sixth Annual Land Surveyors' Conference and to tell you something about the American Congress on Surveying and Mapping. In my opinion, the Congress meets a great need and is worthy of the support of everyone interested in surveying and mapping.

Aims and Objectives

The Congress was started only after very careful consideration and a complete survey of existing organizations to see if one or more of them could meet the needs that were felt to be acute. When it was decided that a new society was necessary, letters were sent to hundreds of men whose interest lay in the fields of surveying and mapping, and an organization meeting was held in Washington in June 1941. This was attended by surveyors in private practice, educators, men from state and government agencies, and representatives of instrument companies. I cannot find my figures on the attendance at that meeting but my recollection is that there were well over a hundred.

The first name of the Society was "The National Congress on Surveying and Mapping" but, in 1942, this was changed to "The American Congress on Surveying and Mapping," due to the great interest aroused among our neighbors in Canada and Latin America. Three annual meetings have been held since the organization meeting as well as many local section meetings. The war has curtailed some of the activities that were originally planned, but the Congress has forged ahead in spite of these difficulties.

Probably I can give you a good idea of the aims and objectives of the Congress by quoting from its Constitution and also from a letter to the members written by Mr. Robert H. Randall of the Bureau of the Budget, the first president of the Congress.

Section 2 of Article I reads as follows:

> The Congress is a non-profit organization whose objectives shall be:
>
> *a.* To advance the sciences of surveying and mapping in their several branches, in furtherance of the public welfare and in the interests of both those who use maps and surveys and those who make them, and to establish a central source of reference and union for its members.

* Reprinted through the courtesy of the New Jersey Engineer, January 1945.

† Vice President, Region 1; Professor of Civil Engineering, New York University.

b. To contribute to public education in the use of maps and to encourage the prosecution of basic mapping programs, especially those programs which are paid in whole or in part with public funds.

Mr. Randall's letter, published in the October 1941 issue of the Bulletin of the Congress, reads in part as follows:

Why have a Congress?—Surveying, and the maps and plats that surveys produce, is fundamental to civilization and progress. It is perhaps the oldest of the applied sciences. Before man could talk with much effect, certainly before he could write, primeval tourists scratched "road maps" in the dust. Some five thousand years ago, a king of Samaria made a map of the world which, because it was on baked clay, we have today. In Egypt, at about the same time, "cursed be he that moveth his neighbor's landmark" was law and almost religion. Today we need surveys and maps to plan and design innumerable works and structures for public and private purposes. Unless we have them our national welfare suffers. To this always present need are now added the requirements of national defense.

In this country, in contrast to other leading nations, there has been no national body to promote surveying. Much has been done in different areas but no effective, co-ordinated effort has been made to have a systematic program. Surveying and mapping are simply taken for granted.

If you ask anyone about his views on the importance of surveying and mapping, he will likely agree with you that these activities are essential. But he assumes that their results are always available. That is, he assumes this until he tries to find something that will fill his needs in some area in which he is interested. If he finds it, he is not particularly impressed. If he does not find it, he is disturbed about it, and, finding that it will cost something to get what he wants, he quite frequently gives it up as a bad job. He feels—and with some justice—that as an individual he can't do much about it. An organization such as The American Congress on Surveying and Mapping can help him and all users at the same time that it promotes the welfare of those of us who are producers of the needed products.

Who will benefit?—It is to be expected that the work of the Congress will benefit not only its members but, because of the fundamental part that surveying and mapping plays in the public welfare, the general public as well.

Practicing surveyors and engineers will be benefited by the opportunity presented for exchanging information and ideas on technical methods, business procedures, and other subjects of interest to them. Those who use surveys and maps, and whose interests are those of the consumer rather than the producer, will likewise profit. They will have a ready and continuing knowledge of what is going on in the profession, and of what is proposed in programs of local, state, or national scope.

Producers and users alike may have the satisfaction of knowing that they are working together for the public good.

What will the Congress do?—This question has, of course, been partly answered in what I have already suggested. More specifically, the Congress will provide, for the first time in this country, a forum where those who are inter-

ested in surveying and mapping may exchange information, and those who as practitioners, informed in technical matters, may exchange ideas for the advancement of the profession.

Still more specifically, the Congress will hold at least one national session each year. Regional sessions also will be held at various times during the year. Local sections are being organized to give members in the larger communities an opportunity to get together on local as well as national questions. Technical divisions are proposed and are now being set up to provide for the study and improvement of practices in such fields as aerial photo-mapping, topographic surveys, municipal and county surveying, and the like.

To implement these congresses, sections, and technical divisions, and to assist in carrying out the general program of the Congress, there has been organized a publication schedule, about which more will be announced later. Provision is being made for the regular publication of Congress reports and for periodic news and technical bulletins, of which this issue is the first.

Who Can Join the Congress?

To quote again from the Constitution, Section 2 of Article II reads:

Members.—Any person interested or engaged in surveying and mapping whose application, filed in the proper manner, has been approved by the Committee on Admissions, upon recommendation of a Regional Officer.

Incidentally, I might add that there is no initiation fee and the dues are $4.00 a year. Surveying and Mapping, the Congress Journal, which at present is published quarterly, is sent to each member without further charge.

You will notice that neither a college degree nor experience in surveying and mapping is needed by anyone wishing to join the Congress. His only qualifications are interest in this field and a proper code of ethics. While this second qualification is not specifically stated in Article II, it is inferred, since an applicant with a reputation for shady practices would be unable to obtain the recommendation of the Regional Officer or the approval of the Committee on Admissions.

In this way, the advantages of the Congress are offered to a large number of people who might find it impossible to join some of the other societies and yet who have a strong interest in surveying and mapping. At the time the Congress was started, a list was made of the groups of people who might wish to join and I think I am correct in saying that each group is represented in our present membership. For your interest, I list the groups below:

1. Private practitioners and land surveyors.
2. County and municipal engineers and surveyors.
3. Employees of commercial mapping and surveying organizations.
4. Employees of commercial concerns engaged in compiling and reproducing maps.

5. Faculty members and students of colleges and universities engaged in presenting courses in surveying and mapping.

6. Employees of state or federal surveying and mapping agencies.

7. Concerns manufacturing the very special items of equipment necessary for surveying, mapping, and photogrammetry.

8. Map curators, map librarians, and map collectors.

9. Public and private organizations that use the results of surveys and maps in some phase of their activity or business.

In addition to individual memberships, library memberships have been taken out by a number of governmental and private libraries, and commercial institutional memberships have been taken out by Aero Service Corporation, The Baker Engineers, C. L. Berger and Sons, W. & L. E. Gurley, Keuffel & Esser Company, and Rand McNally & Company.

I mention these names to show you that the American Congress on Surveying and Mapping has aroused real interest. Now what has the Congress accomplished in 3 years? Several local sections and technical divisions already have been formed and are functioning. The latest technical division to be organized is the Property Surveys Division and its purpose is to improve the practices and standing of this group of surveyors. Over 90 members have asked to join this newest division. Other technical divisions already functioning are: Cartography, Control Surveys, Photogrammetric Mapping, Surveying and Photogrammetric Instruments, and Topographic Mapping.

The first issue of the Congress BULLETIN came out in October 1941 and consisted of 8 pages. Now it is issued quarterly and is called SURVEYING AND MAPPING. The January 1944 issue had 44 pages, the April 1944 issue had 48 pages, while the July 1944 issue had 56 pages. The material included is becoming increasingly of greater value to the members and probably will continue to increase in value as the membership builds up. Let me give you the titles of just a few of the articles that have appeared:

The Land Surveyor
Care of Surveying Instruments
Cartography in Latin America
Applied Plane Coordinates
Strange Property Descriptions
Surveying and Mapping in Canada
Topographic Sketches from Contour Maps
Geodetic vs. Astronomic Control
Survey at Munda
Current Surveying and Mapping Literature

Recently two consultative conferences on geography and cartography have been held under the sponsorship of the Commission on Cartog-

raphy of the Pan American Institute of Geography and History and the American Geographical Society. The first one was in Washington last year and the second was held in Rio de Janeiro from August 15 to September 2, 1944. While these conferences were not held under the auspices of the Congress, some members of the Congress have been very active in them.

I have tried to give you a quick picture of the American Congress on Surveying and Mapping and still keep within my time limit. Possibly Professor Mirgain, who will discuss this paper, may care to amplify further on some of the points I have barely touched on or omitted entirely.

In closing, let me express my appreciation for this opportunity of bringing the facts regarding the American Congress on Surveying and Mapping to your attention and my pleasure at attending one of your meetings again.

* * *

Survey Shows Probable Petroleum Areas

A MAGNETIC survey, by the U. S. Bureau of Mines, of the Florida peninsula shows areas in the lower part of the state that are favorable for the occurrence of petroleum. This first examination of almost an entire state has proved also the usefulness of this type of geophysical investigation for mineral and petroleum exploration over large areas, according to Dr. R. R. Sayers, Director of the Bureau.

Speed, economy, and the large amount of information obtained about the geology and sub-surface bedrock topography of a region are the outstanding advantages of this survey method, he states. A magnetic survey is the logical start in undertaking geological surveys of large areas, especially in regions devoid of out-crops.

Essentially, a magnetic survey is a method of determining the contours of the underlying granites and other formations—known to the geophysicist as the "crystalline basement." A knowledge of the crystalline basement, particularly in areas covered by marine sediments, he explains, is of fundamental importance to oil exploratory work.

Long ago it was observed, he continues, that magnetic masses within the earth, such as iron deposits, would affect an ordinary compass. These localized magnetic forces now have been harnessed by the precision instruments used in a magnetic survey. Employing a magnetic needle free to swing in a vertical arc, they measure variations, known technically as "anomalies," between local magnetic attractions and the normal magnetic field. With this information it is possible to locate magnetic ore bodies, and many other geological formations.

A technical report of this Florida survey has been prepared by the Bureau of Mines and is available at the Washington office.—*Science News Letter,* September 1, 1945.

A Record in Map Production*

A VERY remarkable feat in map production in connexion with the preparation of a map of a portion of France for use in the invasion, which was accomplished by the Canadian Air Survey Organization in a little over 24 hours, is described by Major L. G. Trorey, of the Royal Canadian Engineers, in the October 1944 issue of *The Canadian Surveyor*.

The article opens by pointing out that in war the demand may be for a single individual map, and that the organization and methods necessary to deal with this in the shortest possible time must be very different from those necessary to maintain a steady outflow of different sheets.

The map which forms the subject of the article was a standard 1 : 25,000 sheet, 10 km by 15 km, contoured and in three colours, and covering about 58 square miles. The ground control consisted of French trig. points, and it was possible, with assistance from base maps, to identify a number of the trig. points on the photographs which were used to supply the detail.

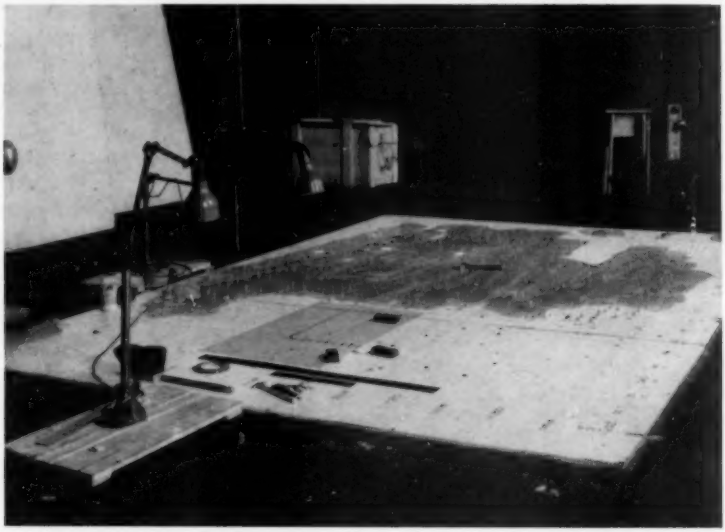
The mapping was divided into the following major operations: Control, Interpretation and marking up, Compilation, Check, Topography, Fair-drawing and Photography. Planning aimed at being able to send the fair-drawing to the camera at the end of 24 hours and at publication taking place about 30 hours after the data were received and the operation commenced. Actually, 24 hours and 10 minutes elapsed from blank photographs to finished fair-drawing, and 29 hours from the delivery of the photographs to the published 50 copies of the three-colour sheet. This record is rather less than half of an estimate given in Professional Paper No. 8 of the Air Survey Committee, where it is stated that, by double banking and by employing sufficient draughtsmen, it should be possible to produce a standard 1 : 25,000 sheet in three colours in about 60 hours.

Work commenced with the receipt at Headquarters of all the data available—trig. lists, base maps on the 1 : 50,000 scale, photographs (4 copies each) and negatives of 6-inch cover—and in 10 minutes all that part of the material which was needed by them was distributed to the various sections concerned. One of the first things to be done was to send the base map to the Map Photo Section to enlarge to 1 : 28,000. Thirty copies of the enlargement were then made on litho stock for subsequent use by the Control and Interpretation Sections.

The Control Section, which was supplied with two copies of each photograph, was responsible for the determination of the grid positions of the photographic principal and minor control points, and this involved

* Reprinted through the courtesy of the Empire Survey Review, April 1945.

the location on the photographs and on a master grid, drawn at somewhere near the assumed mean photo scale, of about nine points per photograph plus any trigs. Having located the control points on the photographs and on the master grid, a control trace was prepared from the master grid and the photographs rectified into this.



SLOTTED TEMPLET CONTROL
Laid out for an area of about 15,000 square miles. Scale 1: 30,000.

Meantime, two copies of each photograph had been distributed to the Interpretation Section. This section, using Zeiss pattern magnifying hand stereoscopes, marked up on the photographs in coloured poster ink all the ground features, except topography, which were to appear on the published map. A library copy of each photograph was used to complete the stereoscope image, this copy not being marked in any way. After interpretation was completed, the marked photographs were passed to the Control Section to have the control points marked on them.

For compilation, a very simple rectifier, specially designed by the R.C.E. Survey and called the "Anharmonic Rectifier," was used. This rectifier was designed on the assumption that the photographs would be of varying scales and tilts, as it was certain that these photographs would not be obtained on straight level flights. A detailed description of the instrument takes up six of the 16 pages of the paper. In principle the

rectifier is very simple, and consists merely of an adjustable easel to support the photograph in an approximately vertical position, together with a special mirror, inclined at 45° to the horizontal, in and through which an image of the photograph and the drawing itself can be viewed together. A simple control knob enables tilt adjustments in X and Y to be affected simultaneously, and all adjustments for scale and tilt are easily made.

As it was not considered practicable to divide the sheets into more than six pieces, it was impossible to employ more than six men at the same time. Speed being essential, each of the compilers worked all out in 30-minute shifts, 12 such shifts being allowed for each piece, so that the total time for compiling a piece was about six hours.

After compilation had been completed, the work of checking was put in hand. This was done on ozalids made from the pencil compilation. Joins were completed, edges made good and each ozalid checked. Amendments and corrections to ozalids were made in ink and then added to the pencil compilation by direct tracing, the tracing then being passed to the camera to be enlarged by photography to the fair-drawing scale—in this case the publication scale of 1 : 25,000. From the resulting negative, zinc plates were made by contact helio, and, from these, blue pulls prepared for the draughtsmen. The process of making a zinc plate and subsequent blue pulls is rather clumsy and long when only a few copies are required. Consequently, a new process has since been devised which will enable contact blue pulls to be made very quickly on waterproof enamelled paper coated with ferro-prussiate solution.

In the Drawing Section, the first pulls of the detail and black were received some 18 hours after "zero" hour, but meantime the surround and everything outside the grid boundaries had been drawn ready for reproduction. On receipt of the black pull, the main roads and railways were fair-drawn and the pull then cut up and distributed, one piece to each of 25 draughtsmen, these pieces being completed, less names, at 22.15 hours after zero hour. Joining up, adding names and checking register took another hour and three-quarters, so that the completed drawing was available for the camera at 24.00 hours. In the meantime, the fair-drawing of the contours and water had been completed by 23.30 hours, the brown having been cut into four pieces so that drawing could be done in 2 hours.

By 24.00 hours all fair-drawings had reached the camera, and at 25.00 hours the three transparencies had been made and issued to the Reproduction Section. Final printing of 50 copies was completed at about 29 hours.

A copy of the first proof of the final printed map accompanies the original article. While the reproduction is naturally not up to the standard of the highest quality Ordnance Survey printing, everything is very

clear and the map is easily read. Considering also that the black was drawn in 25 pieces, it is rather gratifying to see that it is almost impossible to detect the divisions between work done by different draughtsmen.

As regards the man-hours and time taken for different operations, the following figures are given:

Operation	Number of individuals employed on the operation	Man-hours	Elapsed hours per operation
Control	12	71	6
Topography (Multiplex)	7	56	8
Interpretation	20	100	5
Anharmonic Rectifier	12	30 (54 including stand-by time)	4½
Check and join compilation	20	84	4
Fair-drawing (all colours)	30	151	5½
Total		492	

Here all time except officer supervision is included. The number of individuals employed is, however, not the sum of column 2, nor is the total of the elapsed hours given in column 4 the elapsed hours for the job.

It need scarcely be said that an achievement of this kind needs a great deal of preliminary organization and the drawing up of a detailed time-table, with precise instructions for each separate operation. A slightly abridged extract from the original operational orders, giving estimated hours and times for every job, is included in the paper; the actual times achieved appear to have agreed very closely with those estimated. The importance of everyone working and keeping to the time-table laid down was strongly emphasized and all reliefs were carefully arranged. As an illustration of the spirit dominating the instructions, we may quote the following rather amusing passage from those issued regarding compilation, where 30-minute shifts were worked: "Boppists will work a 30-minute task, working *all out*, then be relieved. All out means all out. You don't stop for a smoke, to stretch your legs, to scratch your head. Thirty minutes of really intensive effort."

The organization provided for the supply of meals at convenient times and for adequate rest periods for all key personnel. So keen, however, was everyone connected with the work that men would not go to bed when their task was finished but stayed on to see the finish of the whole job.

Of the lessons learnt from the operation, it was noted that interpretation controls the pace in the early stages of the work because it is impossible to employ more than one man on a single overlap. At the same time, control must keep step with interpretation and finish ahead of it so that minor control points can be added to the photographs immediately they are available. Compilation cannot be subdivided beyond a certain

THE ANHARMONIC RECTIFIER
A "vertical" photograph is shown set up. Notice the tilts of the copyboard.

stage as otherwise there is trouble in joining, and the six pieces used appear to be as many as are advisable. There is also a delay between the completion of compilation and the beginning of fair-drawing, but this delay should be reduced by the introduction of ferro-prussiate-coated enamelled paper for making pulls. In any event, the interval between compilation and fair-drawing is not entirely lost, since it can be spent in road classification and in further checking. Taking everything into consideration, it would be a hard task to do the job in very much less time, and Major Trorey states that, although he thinks it might be possible to publish an edition in 24 hours from the receipt of the photographs, he would hesitate about guaranteeing this.

Surveying Applied to the Needs of Title Insurance*

By PETER W. HEHN†

SAFEGUARDS for holding real estate, which were highly developed in Babylonia, played an important part in civilization for thousands of years and were much more advanced than anything that has yet been found in Egypt. Until a few generations ago general knowledge of the history and culture of Babylonia and Assyria was limited to references in the Old Testament. In contrast to Egypt, no picturesque remains survived to recall to the wanderer the glory of the past.

After the downfall of Assyria and Babylonia these cities fell into decay. The buildings tumbled into shapeless ruins, and the winds sweeping the sands across the plains completed the destruction, and hid even the debris from view. Of the once flourishing cities, one saw only shapeless mounds. In the nineteenth century the excavations of archeologists revealed that beneath these mounds lay buried priceless documents, inscribed clay tablets and cylinders, monuments, and sculptures. It is said that some time between 1878 and 1882 no less than 60,000 clay tablets (most of them business documents) were found in the temple archives in the mounds at Abu Habba, which is located about 25 miles south of Bagdad.

Ancient Boundary Stones

Some remarkable boundary stones were found recording grants of land to royal officials and decorated with symbols of the gods, who were invoked as witnesses to the transactions and whose curses were called down upon anyone defacing or destroying the monuments or altering any of their specifications.

Interpretation of the cuneiform writing which appeared on the wealth of material found was the result of research and study by many decipherers over a period of many years. It revealed the fact that the legal formulas for all kinds of transactions and contracts became fixed as early as 3000 B.C. The tablets pertaining to real property transactions contained a definite location of a house, field, or orchard, the names of the parties, the names of witnesses, and the dates. The attachment of a seal, or of seals, to legal documents was customary from the earliest

* Reprinted (condensed) through the courtesy of the New Jersey Engineer, October 1944.

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period on. The seals were impressed upon the tablets by stamping or rolling; in the absence of a seal the fingernail marks of the contracting parties were scratched on the tablets before they were dried and hardened by the sun. In a general way it may be said that the seal was a guarantee for the validity of the document on the part of the person or persons who yielded certain rights.

It is generally agreed that the earliest source of law was custom. Long before there was anything corresponding to a political organization that enforced rules of human conduct there were family and group customs. The more important customs were generally adopted and enforced. The Roman mind had a distinct genius for law, thus the Romans had a highly developed system of law well adapted for the needs of an advanced and progressive civilization, at a time when some of the rules of English

From Jastrow's, Civilization of Babylonia and Assyria.

Babylonian boundary stone. Nail-marks as substitute for seal.

law were first being cast in written form. The early law of real property was almost wholly customary, and the present law of negotiable paper is said to be chiefly founded upon the custom of merchants engaged in international trade, as it developed in Europe before the year 1700. About that time the English courts began to adopt these customs and enforce them as English law, and the process went on with great rapidity under Lord Mansfield after the middle of the eighteenth century. Hence, with this background of the law the early settlers of East and West Jersey lost no time, after reaching the shores of America, formulating and adopting rules or laws by which to govern the granting of land and the recording of these grants.

Evolution of Title Insurance

When titles were yet simple, opinions thereon were made by lawyers based on searches which they personally made of the records. In those days there were no abstracts at all. When titles became more elaborate, searching became involved and the system of abstracting was initiated. This was almost immediately taken up as an enterprise, distinct in itself and entirely separate from the business of examining a title and giving

an opinion thereon. Abstracting to show the condition of title was usually done by persons or firms organized for that purpose only. The abstract was then examined by a lawyer who rendered his opinion based thereon. Sometimes abstract companies went into the business of examining the title and issuing certificates of title. Others guaranteed the correctness of their opinions of title which were known as guaranteed certificates of title. The final step in this process of evolution is the guaranty or title insurance policy. The first title insurance company came into being in Philadelphia in 1876, since which time the business has spread to all parts of the country. That the institution of the title insurance system in this country was a step forward is best attested by the growth of the business throughout the country, particularly in large cities.

The New Jersey Realty Title plant was organized in 1886, by a group of prominent business men who realized the need for title insurance in New Jersey. After a careful study of methods, the system that had been developed and used successfully in Philadelphia over a decade was adopted. Then the real work began—that of building a title plant. It took a force of over 50 men working day and night to complete the take-off of records from the registers' offices.

Now the Surveyor

However, the history of the title company is another story and is mentioned here to indicate that in the process of issuing title insurance over a long period of years, certain standards have been developed through the knowledge and experience of recognized title experts. A friendly contact has been maintained throughout the years with surveyors all over the state, as a result of which many realize the necessity for the exacting requirements of a title company.

Wherever lands were regarded as a property right to be protected, either by custom or by law, we find the surveyor. We find him in the Egypt of the Pharaohs awaiting the recession of the waters of the Nile to recover and re-establish the landmarks swept away by its rising waters; we find him in early China; and we find him among the Romans and the vast empires they conquered. We find him among the first passengers settling at Burlington, commissioned to survey and lay out plots of ground for the early settlers of West Jersey; and in connection with the searching of titles covering an area of over 30 square miles made for the United States Government by the New Jersey Realty Title Insurance Company in 1941 we found the monuments set by him and referred to as "stones marked with the figures 1790," in a return dated December 29th of that year.

It would be well if each survey were made to conform to requirements

of a title company. This would have a tendency toward the standardization of charges for surveys, because of uniform specifications, and would obviate the necessity of a later revision to conform thereto.

Occasionally I have heard uncomplimentary remarks about the requirements of title companies with reference to surveys. However, it is noticeable that since our Company has been using the present form of requisition it is necessary much less often to contact the surveyor in order to ascertain whether or not this or that detail was observed by him. Then, too, after a surveyor has completed his work on a particular survey and has filled out the reports with reference thereto, he may dismiss from his mind the details pertaining to the job with the feeling that it has been satisfactorily disposed of.

Instructions to Surveyors

The New Jersey Realty Title Insurance Company has established "Instructions to Surveyors" which give the requirements with reference to surveys. The following items are covered:[1]

1. Diagram
2. Boundaries, Lot and Street Numbers, Possession, Windows, etc.
3. Bearings and Distances
4. Building and Lot Lines
5. Streets, Alleys, etc.
6. Rights-of-Way, Access, Cemeteries, etc.
7. Encroachments
8. Party Walls
9. Area
10. Contiguity
11. Certificate

Cases and Points

Many of the above requirements are set up for obvious reasons. However, I shall take the liberty to bring to your attention points that are sometimes overlooked. One of the most important is the question of title against possession, which is aptly covered by Edwin P. Clark in his article entitled "City Surveying for Title Examination" as follows:

> The surveyor who undertakes to make a survey for the purpose of aiding in the examination of the title to a piece of land is called upon to correlate two seemingly incompatible manifolds—the visible, intangible and wholly mental entity called the "Title" and the physical and entirely material fragment of the earth's crust called the "Land." In furnishing this bridge between the seen and the unseen, let us see what conditions he must meet and what obstacles, hindrances, and difficulties he must overcome.

[1] The complete instructions are given in the original article.

The indications of ownership of Real Estate may be divided into two classes: (*a*) Title and (*b*) Possession.

(*a*) Title is established by the change of events evidenced by legal documents of various kinds, including deeds, wills, judgments or decrees in lawsuits, and several others, carried back through a number of years, which bring down the history of the various transfers of the ownership of the property to the present time, and vest the right of ownership or dominion in a definite person or number of persons.

(*b*) Possession is the actual physical appropriation of the land itself, to the exclusion of all other persons, and is evidenced by visible structures of a more or less substantial character, such as buildings, fences and other enclosing devices.

Now it is the function of the surveyor, in making his survey for title purposes, to demonstrate to what extent the possession coincides with the theoretical location of the property to which the documents of the title refer.

The law of adverse possession may affect the property—fence, location, encroachments; evidences of some right-of-way may be the signal of a potential adverse title or right and must be shown by the surveyor. Though the full period of limitation prescribed by law has not run, there may be an adverse right or estate in the making which may give rise to a lawsuit and a loss.

The surveyor should be on the lookout for sub-soil conditions. Recently a survey came into the office, the outline of which was exactly in accordance with the record description. When excavation for the foundation took place it was found that beneath the surface of the ground the foundation of the building upon the adjoining land encroached to the extent of 6 inches upon the premises surveyed. This fact could have been ascertained at the time that the survey was made by driving a spike into the ground close to the wall of the building upon the adjoining property. On surveys where the buildings are on or very close to the line, it would be advisable to take such precautions.

It should be kept in mind that, in most cases, the sketch of the survey reaches the hands of a layman, so far as surveying is concerned, and for this reason it should show details clearly. Most of those whose business it is to read surveys and draw descriptions are familiar with the definition, "Surveying is an exact science," and, believing this, place unbounded faith in the accuracy of the surveyor's work. In view of this confidence the surveyor should make every effort to make the details of the sketch so clear that there could be no chance for misinterpretation.

The surveyor, the lawyer, and the title insurance company have a common obligation; that is, to keep the records straight. It is my belief that the misuse of bearings is accountable for most of the errors that have found their way into the records; reversed bearings and bearings in the wrong quadrants have been due in some cases to errors in the transposing of angles to bearings; other errors have been due to the

mixing of bearing bases. In many instances the bearing bases are changed in order to bring the survey to date as to meridians, and this is done in accordance with basic principles of surveying. However, for the purposes of conveyancing and for the records, it is obvious that this practice creates a hazard in the drawing of descriptions as well as in searching. Therefore, it is suggested that thought be given by the surveyors to the showing of interior or exterior angles as well as deflection angles on their survey sketches. Perhaps the lawyer might need some help at first in drawing descriptions with reference to the directions and the included, excluded, and deflection angles; but this could be overcome with the help of the surveyor in drawing descriptions for his client. It seems to me that this change would in the first place save work for the surveyor by eliminating the necessity for transposing to bearings, and secondly would help the lawyer and searcher in the comparing and plotting of descriptions. If it were thought necessary to show a bearing, it could be shown as applied to the street line.

Many instances could be cited wherein the survey showed a street having a width of 50 feet, while record width thereof was later found to be 50, 66, or 75 feet. The utmost care should be exercised by the surveyor in this respect.

The means of access to the premises in question, or a notation as to the absence thereof, is most important. The law implies a right by necessity, but it is surprising how often a parcel has been conveyed without providing for access thereto or therefrom; and the presence of a cemetery or a burial plot certainly can involve matters. Invariably an exception under "Schedule B" of the policy is necessary to cover outstanding rights therein and access thereto.

There should be no question as to interpretation of encroachments. The possibility of misinterpretations as to encroachments could be overcome by making the sketch on a large scale; then the notations could be placed so that the details would be obvious. It is the writer's opinion that in the cases where buildings, fences, etc., on the land surveyed encroach upon adjoining lands, the notation thereof should be placed within the outline surveyed; and where buildings, fences, etc., of adjoining lands encroach upon the premises surveyed, the notation thereof should be placed outside and adjacent to the outline of the premises surveyed.

Where it is not practical to determine the condition of the walls of buildings on the premises surveyed, or upon adjoining lands, a note should be prominently placed on the sketch of the survey: "This survey is subject to latent wall conditions," or "This survey, having been made over roofs, is subject to such slight variations as a ground survey may show." As to acreage, it is often necessary to know the exact area

of the premises surveyed, because of the fact that the consideration is based upon the price per acre.

Contiguity, as you well know, is very important. Its discovery may make it possible to acquire the outstanding interest or at least that steps may be taken to quiet title before the area in question might be subdivided, built upon, or, in the case of lake sites, might be flooded by the building of a dam.

A little bit of land can cost a lot of money when the land is needed to iron out a flaw in the title as illustrated by the following story which recently appeared in a Toronto newspaper:

Frederick Brown received a telephone call last Friday from a Toronto broadcasting station:

"Is it true that you have purchased a lot 4 inches wide?" came the voice from Canada. "Is it also true that for ninety years this property had been lost, had no legal owner? And is it true also that you paid $1,500 for this sliver of land?"

"Yes, that is all true," Mr. Brown said, "but what interest has Toronto in what I am doing and in 4 inches of land when you have so much up in your country?"

The broadcasting company official said that he considered this deal so interesting that it was decided to put it on the air as a human interest story.

So, Canada was told of the "no man's land" Mr. Brown bought at the rate of $90,000 for a lot 25 feet wide.

Both honesty and accuracy are fostered by surveying. One must be absolutely honest and accurate in his survey practice, not only to his associates, but to himself. No mental evasion or play upon the weakness of humanity will cover up errors or make poor work check properly. This in effect should be the "creed" of the surveyor.

❦ ❦ ❦

Postwar Travel Forecast

A SURVEY of postwar travel, based on expressed plans of thousands of individuals, showed that only 25.09 percent of the queried persons intend to travel for business, while the remainder will travel for pleasure, according to a recent issue of *Ships*.

The magazine said that 80.64 percent had expressed the desire to travel exclusively by ships. Slightly more than 12½ percent indicated a preference for a combination trip, using ships and planes, and the rest, roughly 6½ percent, said they would travel both ways by air.—*The New York Times*.

New Military Surveying Equipment by Corps of Engineers*

By MAJOR WILLIAM S. LITTLE†

PART of the work of engineer topographic units in combat consists of establishing control for maps and for field artillery fire control. This involves many kinds of surveying under widely varying field conditions. Conventional methods, sometimes modified to meet military needs, are used extensively. These include triangulation, tape and stadia traverses, planetable surveys, azimuth determination, astro-fixes, and differential, trigonometric, and barometric leveling. Special equipment and technique are sometimes required to do tasks peculiar to military surveying. Some of the equipment that has recently been developed will be described.

Military Theodolite Reading to One Second

In military surveying, a light-weight instrument is needed that can be used for turning the angles of a triangulation net in the minimum of time. Any reduction in the time required to do field work is extremely beneficial, as one of the principal uses of triangulation nets in combat is to tie together primary artillery control surveys so that fire may be directed as early as possible on a common target by any combination of batteries within range. As the observer may be an excellent target for enemy observers and snipers and for other fire, it is desirable to use an instrument that can be read quickly a couple of times to get sufficiently accurate results. Formerly the Army used the foreign-made Tabistock and Wild theodolites, but these were no longer available after the war started. Even before that time, the Corps of Engineers had recognized the need of developing manufacturing facilities for this type of instrument in the United States, and steps were taken to secure pilot models from American surveying instrument makers.

The theodolite shown in figure 1 is the first of the models now in production. It was built by W. and L. E. Gurley, of Troy, New York. The telescope optics were designed under an NDRC project, and the circles were graduated by the U. S. National Bureau of Standards. This theodolite is a directional instrument of the optical coincidence type, reading directly to 1 second. Tests on fixed collimators show that the instrument is at least equivalent in accuracy to the similar foreign-made theodolites

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tested, and probably more accurate. It is similar in principle and operation to the small Wild theodolite.

FIGURE 1.—Theodolite developed by Engineer Board reads directly to one second.

SYSTEMS OF PRISMS USED

The circles are stainless steel, 4 inches in diameter, graduated every 20 minutes, and numbered at every degree. Reading is made through a microscope mounted rigidly on the right-hand side of the telescope and is accomplished by a system of prisms which brings together the images of the graduations from directly opposite sides of the circle. Another system of prisms, actuated by a knurled knob, is used to bring the two sets of graduations into apparent coincidence. When perfect coincidence has been obtained, the degrees and even 10 minutes are read from the circle against a fixed index line in one part of the reading microscope field.

In another part of the same field, the additional minutes and seconds are read on a scale 10 minutes long, which is connected to the prism system in such a manner as to divide a 10-minute interval on the main circle into exactly 600 seconds. A two-position knob which moves another prism provides for reading, by the same microscope, either the vertical or the horizontal circle. Provision is made to set the horizontal circle at any position by another knob through a gear train which can be disengaged to prevent accidental derangement by the operator.

The altitude level bubble is read from the observer's normal positions through a prism system. Half of each end of the bubble, split longitudinally, is seen in the field so that when the ends are made to coincide by moving the vial, it is perfectly level. An optical plummet for use on towers or on the ground is furnished in addition to the plumb bob. The electric illumination system provides for night operation and is so designed that very little stray light is visible. At 100 yards the instrument can be operated without being seen, except by a person directly in line with the telescope, who may detect a faint glow from the reticle at a slightly greater distance.

The star sights, the plate level, and the circular level on the tripod are illuminated by radioactive material so that they can be used at night to full advantage. Power is supplied from a battery case strapped to one of the tripod legs. A watertight metal case, with rubber shock-mounting for the instrument head, is furnished, as well as an outer wooden packing case padded for further protection. All accessories and tools are packed in the metal carrying case or in another small metal container.

A capsule is clipped to the inside of the metal carrying case, containing a desiccant to keep the instrument head dry in the excessively humid conditions found in the tropics, or to prevent excessive condensation resulting from sudden temperature changes. The desiccant contains an "indicator" which changes its color from blue to purple when the ambient humidity becomes too high. A spare capsule is furnished for use if needed; or the original can be dried out slowly in an oven and used again. Every effort has been made to make the outfit weather-proof. A special pack is provided for back packing the instrument head in its metal carrying case. This is made principally of light-weight metal tubing welded together.

Semi-Precise Military Level

Another instrument specially designed to meet military needs is the semi-precise level built by C. L. Berger and Sons, of Boston, Mass. (Fig. 2). Its purpose is the quick accomplishment of second-order and third-order differential leveling. It is a tilting, dumpy-type instrument with differential vertical tilting screw and means for reading the level bubble

from the eyepiece end of the telescope. It is fully night illuminated by an electric lighting system which can be detached for daytime use. The telescope, of the internal-focusing type, is inverting, and is furnished with a glass reticle. The telescope is tilted about a lateral pivot located directly over the spindle by means of a differential tilting screw placed under the eyepiece end of the telescope.

A universal (circular) level vial, mounted on the base of the instrument, allows approximate leveling of the head; final leveling is accomplished by tilting the telescope so that the two ends of the main level vial, as seen through a reading microscope mounted on the left-hand side of the telescope, are brought into coincidence. The bubble is "split" by a prism system similar to that used for reading the altitude level in the theodolite previously described. When coincidence is obtained, the rod may be read.

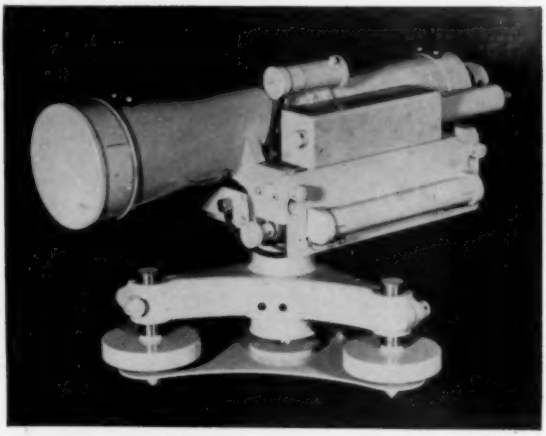

FIGURE 2.—Military level designed to quickly accomplish second- and third-order leveling.

With this instrument, setups can be made very rapidly. When used at night, the instrument shows very little stray light, being invisible at about 200 feet. The glass reticle in the instrument is permanently fixed in an accurately made cell, which can be replaced easily. A positioning pin insures that the new reticle will be in the proper position in the instrument, and no further adjustments need be made except that of the main level vial by the usual "peg" method. Power is furnished from three flashlight batteries in a separate watertight case.

All tools, accessories, spare bulbs, and a spare level vial and reticle cell are packed in the carrying case, which is made of mahogany. The tripod is made of oak and is of conventional design. Many other design features, too numerous to mention here, contribute to the ease and speed of operation of this level.

Pendulum Astrolabe or Equiangulator

A new instrument, the 60° airdampened pendulum astrolabe (or "equiangulator") has been invented by John E. Willis, formerly of the U. S. Naval Observatory. (Fig. 3.) The pilot model of this instrument was

Figure 3.—Pendulum astrolabe measures time of transit of a star across the 60° altitude circle.

built by the David White Company, of Milwaukee, Wis., and this firm is now producing it in quantity. It is used in conjunction with a chronometer, a stop-watch, and radio time signals for getting astro-fixes to within about 200 feet, for the ground control of maps and charts in areas not controlled by survey or previous astro-observations.

The accurate time of transit of a star across the 60° altitude circle gives a "line of position" to within a few seconds of arc. Several "lines of position," at evenly spaced azimuths around the horizon, give a fix. This is similar to the "line-of-position" fix methods in navigation, using an assumed position. However, more stars are used, more rigorous formulas are employed, and the computations are carried out to more significant places.

As long as the instrument indicates the star's transit at exactly the same altitude during a series of observations for one fix, no matter in which azimuth the astrolabe is pointed, the altitude angle does not have to be exactly 60°. No correction need be made for refraction, as the altitude angles are all equal, assuming that changes in air temperature and pressure remain nearly constant, or are too small to affect the resulting fix.

This astrolabe consists of an 80-power telescope "split" so that the optical axes of the objective lens and the eyepiece assembly lie in the same vertical plane and are close to 30° from the vertical axis of the instrument, but on opposite sides. An accurately ground surface mirror, mounted horizontally on an air-dampened pendulum, is located at the intersection of the two optical axes so as to reflect rays from the objective back up into the eyepiece assembly, which contains a glass reticle.

MIRROR REPLACES MERCURY

Except for the use of a mirror mounted on a pendulum, this device is similar in principle to the de la Baume Pluvinel bent telescope astrolabe, which employs mercury instead of a mirror. However, a very slight change in the height of the mercury in the bent telescope astrolabe will change the apparent altitude of a star, which makes it impractical for field use. The fixed length of the pendulum eliminates this as well as all the difficulties and nuisances of using mercury. The pendulum is hung on a thin double-cantilever spring-suspension system that allows swinging fore and aft, and also sideways. Fore and aft displacement of the mirror stage by reason of action of the lateral suspension springs, when the instrument is slightly out of level, is compensated for.

Air dampening is accomplished by means of two vertical fins fixed to the bottom of the pendulum stage, placed vertically and at right angles to each other, in the form of an "X" when viewed from below. (Fig. 4.) Corresponding plates spaced $\frac{1}{2}$ mm from each side of each face of the pendulum fins are fastened to the base of the instrument proper. The resulting thin air spaces act like a viscous fluid and effectively dampen the swing of the pendulum so that it comes to rest in about 6 seconds of time after the instrument is disturbed—as in pointing at a new star.

This is at least as quickly as a bowl of mercury will come to rest in the conventional astrolabe.

The base of the instrument consists of a conventional leveling head and an azimuth circle similar to that in balloon theodolites. The circle is graduated to even degrees and serves to point the instrument at the proper stars, as listed in the 60° star tables. A trough compass is used

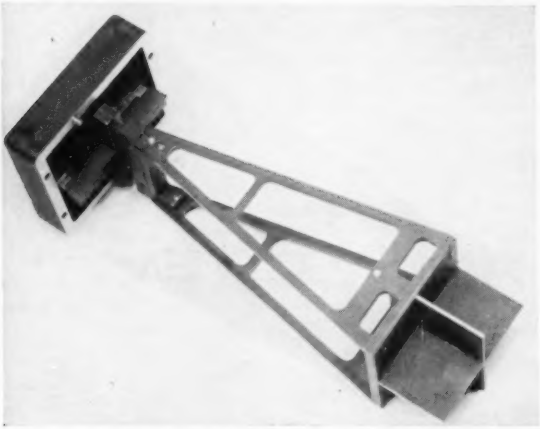

FIGURE 4.—Pendulum of astrolabe is spring suspended and air dampened for rapid dampening.

for preliminary orientation. A low-power finder is provided to help locate and identify stars. A tripod and all accessories are also furnished.

ACCURACY HIGH

Tests show the pendulum astrolabe to be as accurate as the conventional prismatic instruments and probably more so. It is less than half as heavy, is easier to build, and costs about one-fifth as much to produce in the United States as the equilateral prism instrument. It is also easier to operate and will function below the freezing point of mercury.

For several reasons, full advantage is not taken at this time of the potential instrumental accuracy of this model of the astrolabe, which is on the order of 0.1 second of arc. The deflection of the vertical cannot be measured in the field directly, is unpredictable in direction or magnitude, and may cause many hundreds of feet of difference between a geo-

detic and a corresponding astronomic position. Only a triangulation net covering a large land area and tied to many stations whose astronomic positions have been accurately determined, will give the values of the plumb variation with any degree of certainty.

As has been indicated, the military use of astro position-finding equipment is to get the best possible control where no basic survey control exists, and where it is impracticable to establish it. An example of this would be for the immediate control of aerial photomaps and charts of remote land areas where astro-fix parties could operate, but where field surveys would be impossible or not feasible. Further refinement of an astro-position good to 200 feet or better is not warranted, since much larger errors usually exist as a result of the plumb variation, which cannot readily be isolated. Also, the scale of the map or chart being prepared is usually so small that an error of 200 feet cannot be plotted. Further considerations include the extreme difficulty of getting time in the field more accurately than to about 0.1 second, and the fact that the simpler and lighter this type of equipment is, the better suited it is for Army field use.

There is little doubt that, with refinements in observing, recording time, computing, and eliminating personal errors by photographic or mechanical means, this instrument will have extensive and important peacetime use in applied astronomy.[1]

Zenith Camera Developed for Military Use

The pilot model of the 12-inch focal-length Zenith camera, shown in figure 5, was developed for the Army Air Forces to get ground control directly by photographing the stars near the zenith. The camera is set on the ground, carefully leveled, and two exposures are made, the camera being rotated $180° \pm 1'$ for the second exposure without disturbing the instrument. Exact time is taken of the mid-point of each exposure. The star images on the photographic plate are then measured on an accurate comparator, and the position of the zenith is computed from the known relative positions of the stars and the time of exposure. The position of the zenith with respect to the equator and the prime meridian is, of course, the astro-fix of the camera.

Tests indicate that astro-fixes good to about 300 feet may be obtained with this camera. The advantages of using this method for astro-fixes, as against the transit, theodolite, or astrolabe, are (1) that all that is required is a few degrees of clear sky at the zenith; and (2) that the station need not be occupied for several hours, a procedure which is necessary with other methods, and may be undesirable in military operations.

[1] For method of compensating for mirror tilt see article in Civil Engineering, July 1945, by same author.

Disadvantages include the fact that it takes considerably longer to compute the fix and that the computations are not self-checking. Only a complete computation of another plate exposed at the same location will guarantee against the innumerable chances for error in this type of solution. Also, plates must be developed in the field before leaving the station to insure that good exposures have been made. This is often a difficult procedure. The pilot model shown was built by David W. Mann, of Lincoln,

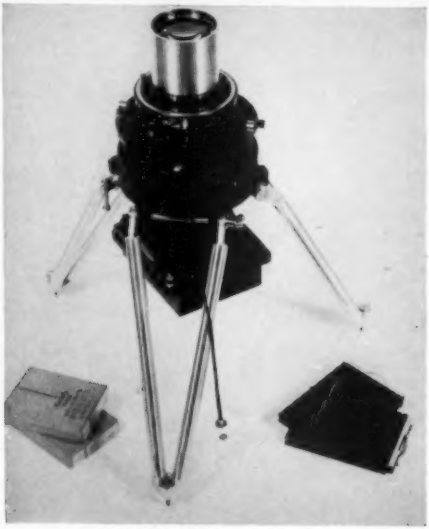

FIGURE 5.—Zenith camera ascertains location by photographing stars near the zenith.

Mass. Another successful experimental model of somewhat different design was made by the Eastman Kodak Company, of Rochester, N. Y.

SURVEYING ALTIMETER

Use of the altimeter (aneroid barometer) for determining elevations in mapping is applicable to military surveys where accuracies to within 10 feet are needed. The Army uses one instrument at a fixed station of known or assumed elevation and one or more altimeters for getting the relative ground elevations within a radius of about six miles of the "base" instrument. Comparisons between altimeters for calibration purposes are made at the start and at the end of a run. Readings on the instru-

ment and on the thermometer are taken every five minutes on the base instrument and similar readings are made at some even 5-minute interval on the other altimeters.

All watches are synchronized at the beginning and at the end of the run so that corrections can be made to the individual readings to counterbalance changes in atmospheric pressure for the whole area being surveyed. It is assumed, of course, that these changes are constant for the area. Corrections for temperature are made from a nomograph in the lid of the instrument. Closure errors are prorated over the circuit.

FIGURE 6.—Portable survey beacon has fluorescent cloth for unusual brilliancy.

While more precise results are obtainable by more elaborate procedures, the method outlined is sufficiently accurate for many military purposes. Further refinement in method or equipment is not considered desirable for military use. The altimeter is manufactured by Wallace and Tiernan Products, Inc., of Belleville, N. J., and reads up to 6,000

feet in 10-foot intervals. Another similar model is furnished, reading to 15,000 feet at 20-foot intervals. In the field it is carried in a rain-shedding canvas carrying case.

Survey Beacons of Portable Type

A portable survey beacon for use in triangulation has been developed, copied somewhat from that used by the British. (Fig. 6.) The unusual feature is that fluorescent signal cloth is used for the canopy and the flag. On overcast days the colors are still brilliant and easily seen. The beacon is designed so that an instrument can be used under it, and electric signal beacons can be clamped to the cross-beam under the canopy. These serve as foresights at night, and under certain circumstances are used to advantage in daylight.

The work of developing and testing methods and equipment for the Corps of Engineers is the responsibility of the Engineer Board, headed by Brig. Gen. John W. N. Schulz, President, with Col. W. J. Matteson as Executive Officer. The work of developing and testing surveying equipment is the responsibility of Maj. W. C. Cude, Chief of the Mapping Branch, and of the writer.

* * *

Pocket Compass

ONE of the most popular items with the Army Air Corps is a pocket-size, dial-type, liquid compass, attached to a case which holds small water-proof matches. Together with its case it weighs less than two ounces and resembles a flashlight battery. It is 3 inches high and 1 inch in diameter. Military specifications for this pocket compass call for the same rigid tests as those given to standard compasses on B-29's and other fighting aircraft. Such a fine degree of accuracy is required that a variance of 0.0005 inch would result in rejection. This is necessary because the all-purpose pocket compass must be able to stand up under all sorts of service conditions.

The compass, which contains 16 separate parts, is injection molded of Tenite II at a slow cycle to keep maximum dimensional control. The units are produced at the rate of 2000 daily by DuPage Plastics Company. The sighting window on the compass is Lumarith.—*Scientific American*, August 1945.

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

SOIL CONSERVATION SERVICE*

Department of Agriculture

A SOIL conservation surveyor recently stopped at a farmhouse in western Kentucky to inquire directions. When he told the farmer he was out looking at the land and wanted to see what farmers had done to control erosion, the farmer's smile of greeting broadened to a grin, and he asked the conservationist to wait as he disappeared into the house.

Returning promptly, stuffing a folder into his hip pocket, he motioned his visitor to follow him. They stopped first on the crest of a ridge a few rods back of the buildings. The farmer pulled the folder from his pocket and opened it to an aerial photograph.

"Here are my buildings," he said, pointing to several black squares on the photo. "The farm stretches back about four inches on the map, which is one-half mile."

"Here is my alfalfa; I want you to see it," he added, indicating an area colored green and almost surrounded by a blue line at the top of the map.

He confided as they walked over the farm that he and his wife once had about given up. They thought their old age would be one of poverty and despair, until a neighbor interested them in soil conservation 5 years before. Most of their land was rolling, except for several acres along a stream. The stream meandered through this field, frequently overflowed and kept it wet. Yields of corn and wheat on the eroded hillsides had dropped so low that they were no longer profitable. Income most years was too low to buy the necessities of life.

There were nearly fifty head of cattle in the pasture next visited. The grass looked as if it has not even been grazed. The farmer explained that he had seeded all his upland to grass and fenced it into three pastures. Some of the cattle were drinking from a trough a few rods beyond a fenced-in pond. From a detailed map of the pond he told the soils man the height of the earth dam, the details of the spillway, and the acreage of the watershed above the dam.

He then showed from the aerial photograph how the alfalfa field

* Prepared in the Office of the Soil Conservation Service.

looked before it was treated. The stream channel had been straightened, the field leveled, and a diversion ditch dug at the base of the hill to carry the runoff water from the hills. The alfalfa stand was excellent.

Aerial Photographs in Soil Conservation Work

Though he had to borrow money to buy seed, fertilizer, fencing and other materials, supervisors of the local soil conservation district had lent him equipment to construct terraces, level land, straighten the stream channel, and build ponds. The neighbors helped him with labor. So it is that the Soil Conservation Service not only has found maps essential in its technical work of soil and water conservation, but it has learned that teaching farmers to read them helps "make" conservation farmers. Large-scale aerial photographs appeal to farmers, because they can see their buildings, fences, fields, and many other objects on the farm. They can readily relate one point with another on them. Aerial photographs make it rather simple to explain the location of various conservation practices planned for the farm. They have helped the farmer materially to understand land conditions—and that each acre should be used according to its capabilities and treated according to its need.

Aerial photography was recognized as a requirement for soil conservation operations as early as 1934. Since then, the Service has awarded contracts to commercial companies covering more than 400,000 square miles. The majority of this aerial photography has been at a scale of 1:20,000 with an 8¼-inch focal length lens, although a scale of 1:31,680 with a 6-inch focal length lens has been used rather extensively. On a few projects, smaller scales and shorter focal lengths have been used. Through exchange, aerial negatives of other federal organizations have been used by the Service. Of the more than 400,000 square miles of aerial photography, approximately 150,000 square miles included the delivery of controlled aerial photo-maps. It is believed the Soil Conservation Service was the first federal agency to use aerial photography on an extensive scale for purposes other than the compilation of planimetric and topographic maps.

The Soil Conservation Service is not primarily a map-making agency. It compiles maps only when suitable bases are not available on which to surcharge various soil conservation data. For many field operations, aerial photographic enlargements are more satisfactory than planimetric or topographic maps, because of the wealth of detail they contain and the value of this detail to soil conservation technicians and farmers. An aerial photographic laboratory is maintained in which contact prints, enlargements, and other photographic material are produced. The present rate at which soil conservation districts are being established and at which new photographs are being taken requires the preparation of approximately 350,000 contact prints and enlargements a year.

The use of aerial photographic mosaics or photo-maps simplifies many field problems. This is particularly true where farms or ranches are so large that several photographs are needed for complete coverage and where conservation problems involve a group of farms. Photo-maps generally are compiled by using existing horizontal control and bridging between this control with the slotted templet method of radial control.

Ratio and tilt factors are computed from measurements made between the radial control points on the photographs and their position as located by radial control. These factors are applied to the original negative, and the resulting prints are mounted on the points located by radial control assembly. The scales generally used for compiling photo-maps are 1 : 7,920, 1 : 15,840, and 1 : 31,680. Including the photo-maps compiled by the Service and those prepared under contract by commercial companies, an area comprising approximately 200,000 square miles has been completed.

Survey and Map Work

Most of the maps published by the Soil Conservation Service require a planimetric base upon which conservation survey and land capability data are surcharged. Because planimetric maps are compiled only when suitable bases are not available, it usually is necessary to establish considerable horizontal control. All control surveys are monumented and closed in accordance with established survey practice. The method used to compile planimetric maps utilizes the slotted templet method of radial control and Multiplex projectors.

The manuscript map is plotted generally at a scale of 1 : 12,000. Before the color separation boards are drafted, a complete field edit is made. All of the maps published by the Service are on the State Plane Coordinate Systems, with the polyconic projection ticked in the margin. The conservation survey data usually are delineated on aerial photographs in the field, and these data are transferred to a blueline copy of the manuscript map with overhead reflecting projectors, using the culture and drainage features as control. More than 10,500 square miles of this type of map have been published. These maps, with a report on the physical land conditions of the area covered, are available from the Government Printing Office, Washington, D. C.

For certain areas, large-scale, small-interval topographic maps are needed. This type of map is compiled for research areas and where extremely complicated agricultural problems exist. For a great many small areas where land leveling and irrigation problems are involved, it is necessary to prepare topographic maps at a scale of 1 inch = 200 feet with a 1- to 2-foot contour interval. This type of topography is required for applying conservation measures to the land, and is similar to the

topography required for many types of construction. To date, these topographic maps have been compiled by field methods, although consideration now is being given to preparing these maps by a combination of aerial and terrestrial photogrammetric methods.

Various types of reconnaissance maps are made and reproduced. Most of these are compiled from existing maps and, when necessary, are brought up to date with aerial photographs. These maps are generally published at scales smaller than 1 : 125,000.

The Soil Conservation Service has a small reproduction plant in which conservation survey, land capability, and other required maps are reproduced.

War Mapping

During the war, the Service compiled and reproduced planimetric and topographic maps, aeronautical charts, photo-maps, and various other material for the Corps of Engineers and the Aeronautical Chart Service of the War Department and for the Hydrographic Office of the Navy Department. This work required virtually all of the cartographic personnel and facilities, for a considerable period.

Now that all of its energies are to be devoted to peacetime pursuits, however, the Service will be able to concentrate on making all of the maps that are essential to planning and carrying out the techniques of soil and water conservation. It also will continue to help farmers understand these maps.

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Wider Scope for Beach Erosion Board

Wide expansion of the authority of the Chief of Engineers, through the Beach Erosion Board, to make general investigations with a view to preventing erosion of the shores of the United States, is contained in H. R. 2032, recently signed by President Truman. Under the new law the cost of the general investigations will be borne wholly by the United States. The former law, Act of June 26, 1936, is repealed by the new measure.

As used in the new Act, the word "shores" includes the shore lines of the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, Lake Champlain, and estuaries and bays directly connected with these bodies of water. Lake Champlain is a new addition to the list of bodies of water subject to investigation, and was not included in the former bill. In addition to participation in co-operative investigations and studies with agencies of the various States and determining the most suitable methods for the protection, restoration, and development of beaches, the Beach Erosion Board will publish from time to time such useful data and information regarding the erosion and protection of beaches as the Board may deem to be of value to the people of the United States.—*The Military Engineer*, October 1945.

Eight Million Maps a Year

By FORREST M. BURKE*

THE Automobile Club of Southern California, through its main office and its numerous district offices, distributes in a normal year approximately 8,000,000 maps to its members and to visiting motorists. Like most automobile clubs, it is a combined service and insurance organization with over 150,000 members and over 1,100 employees. The maps are distributed through two channels; the Touring Bureau, the outlet for the highway maps, and the Outing Bureau, the outlet for the maps of special interest to fishermen, hunters, and campers.

Several types of maps are issued, but the sectional quadrangle-type for parts of southern and central California is being given the most attention at the present time. These quadrangles in some instances include a county, while others are designed to fit an important geographical or political area. The majority of these maps are drawn to a scale of $\frac{1}{2}$ inch to the mile, the size of the original being approximately 34 by 46 inches. When reduced for distribution the printed size is 17 by 23 inches on a scale of $\frac{1}{4}$ inch to the mile.

Data for making the maps are obtained from two general sources: the Map Department files and field reports. The first contains a large number of country, state, county, city, and special area maps. There are also many highway alignment charts from various western states, many folders of resorts, cities, states, national parks, and other recreational areas throughout the West (including Canada and Mexico), and lists of railroad stations, census data, etc. As to government maps on file there are national forest sheets covering the western states, hydrographic charts of our Pacific Coast, a file of U. S. Geological Survey topographic quadrangles covering the entire United States, and numerous Canadian topographic quadrangles.

For obtaining the field data the Club operates three truck-and-house-trailer units, each carrying a crew of three men. Before going into the field all the road alignments, and other data of interest to motorists, are first plotted on U. S. Geological Survey quadrangles covering the area to be mapped. The truck and trailer proceeds to the approximate center of the area to be mapped and the trailer is left there as "home." One of the crew stays with the trailer to act as housekeeper, cook, and dish washer. He also inks in on a master copy of the map the field work done on the previous day. The other two men go forth every morning to cover more of the area to be mapped. One is the driver and the other, while

* Cartographer, Automobile Club of Southern California.

riding along, draws in information such as roads, road surface type, bridge dimensions, buildings, parks, and other information of interest. At the same time each topographic quadrangle is checked for any additions, deletions, or errors which may appear. Many of these, with changes noted thereon, have been sent to the proper governmental departments to be used as reference when revisions are undertaken.

Maps are drafted in our Map Drafting Department. In preparing the maps for publication all roads, railroads, drainage, boundaries, mountain peaks, and points of interest are drawn on tracing cloth. From this a brown line print is made and mounted on a pressed wood panel or on cloth. All city and town names, notations, and names of lakes, creeks, rivers, and valleys—in fact all names to appear on the map—are printed in a suitable style of type and pasted on the map in their correct locations. After the completed map has gone through a thorough checking and the index for the back has been prepared it is then sent to a local lithographic company for printing.

Maps are printed in four colors, namely: deep blue, for nearly all lettering, roads, drainage, railroads, some boundary lines, notations, mileages, etc.; red, for many boundary lines and the names in conjunction with these lines, federal and state route numbers, and accumulated mileages; turquoise blue, for lake, wide river, and ocean tints; and light gray, for relief shading.

In the color separation work the procedure is as follows: The plates for the deep blue and red are made from a single negative, the result of photographing the map. This negative is prepared for making the blue plate by deleting all the red features with opaque water color. After the blue plate is made the negative is washed clean of the opaque and all blue features are obliterated for making the red plate. During this process, which is done in the Map Department, the third plate (turquoise blue tint) is being made by the lithographic company.

For the relief shading, U. S. Geological Survey topographic quadrangles and other available contour maps are used for reference to make copy for the relief shading plate (light gray). The complexities of contours are mentally simplified by the cartographer who draws "mountains in relief" on a ground glass plate with a black wax crayon. The lithographic plate is then made by photographic exposure from the glass "copy."

As a general rule the maps are printed on a two-color press. First, the gray relief and the pale blue water tint are printed (at the same time), and then the dark blue and red are printed on top of the first run. The various maps are printed 5,000 to 20,000 at a time depending on the popularity or demand of the area mapped.

"Eight million maps a year" does not apply to the present as we are

not having normal years. The maps that are being made now are widely used by the Armed Forces and governmental agencies located in Southern California.

* * *

HOW SOON CAN YOU PACK?

When I became the blushing bride of a civil engineer
How little did I think my life to others might seem queer,
To those who settle down for life with fixings that are new,
A bed, a lamp, a dinette set, to mention but a few;
Who polish up their wedding gifts, and shine up pots and kettles,
And hang up drapes of gay cretonne, and chase the dust that settles.
They hope to do this always in their own artistic home,
And look with pity on their friends whose lot it is to roam.

Now we whose lives have taken us to many different places,
Have met folks north, south, east, and west, and even alien faces.
We've lived in nipa shacks and huts, apartments and in flats,
We've answered ads for "lovely rooms" and found them full of rats.
We've taken rooms in "mansions"—that's the landlord's wily phrasing.
(We've learned from much experience to do our own appraising.)
We've eaten hearty dinners on a rolling ocean liner,
We've eaten just as hearty in Al's Kozy Korner Diner.

We've camped in pleasant valleys, and we've scaled the mountain peaks,
And we've sun-tanned by the ocean, and fished in sparkling creeks.
We've rustled food from markets, and from a grocery shelf,
And lived on farms where food that's fresh seemed just to grow itself.
We've gathered luscious fruit from trees, in Texas or Cebu,
And pienicked on a glacier when the sun shone at Taku.
In fact, what most folks think of as an elegant vacation
Is standard stuff for map makers, in spite of transportation.

The lucky wives can go along; and for those who like to roam
It's a challenge to see what it takes, to make a place called home.
You do not need a davenport, or whatnot—just a broom—
You can get the spirit nicely in a little furnished room.
You can learn to be a gypsy who loves to pioneer,
You do not have to settle down when mapping's your career.
For it's "Here, my love, and there, my love, and how soon can you pack?"
For it's "Here, my love, and there, my love, across the world and back!"

—N. C. B.

Detail Mapping by the Use of Enlarged Aerial Photographs*

By JAMES W. LITTLETON†

DURING the period when the volume of military construction in the southwestern part of the United States was very large, the Mapping Section of the Little Rock Engineer District was often assigned urgent mapping projects. As a larger percentage of the more experienced survey and mapping personnel were in the armed forces, some of these assignments could not have been completed on schedule had the common procedures for surveying and mapping been used.

Probably the most critical assignment of this type was that requiring the detailed mapping of five auxiliary airfields, each approximately one square mile in area, in about seven days at a time when only two topographic survey parties of four men each were immediately available to accomplish the field work. A very successful method involving the use of enlarged aerial photographs was devised to meet the situation. By using this method, the detailed maps were obtained for this assignment in about one-fourth of the time that they could have been completed by the usual planetable methods and they were found to be very accurate.

The following steps were used to accomplish the mapping:

1. A small-scale aerial photograph covering the area to be mapped was enlarged to approximately the desired mapping scale.
2. The enlarged photograph was used as the planetable base sheet. Contours and critical elevations were added by planetable and alidade and other pertinent data such as crop outlines, cultural features, and all obstructions to construction were surcharged onto the sheet in pencil form.
3. The contours, topographic features, and other data were inked on the sheet by a draftsman using standard conventional mapping symbols.
4. The irrelevant photographic emulsion was then bleached from the photograph to make a line map, and a standard border line and a title block mask were added.
5. The line map was then photographed, and the resulting film negative was opaqued and reproductions made from it to the exact scale desired.

Detailed Procedure

Enlarging the Aerial Photograph.—The most recent aerial photograph negative on which the area to be mapped occurred was selected. This area was masked, blocking out the area that was not to be used.

* Reprinted through the courtesy of Photogrammetric Engineering, September 1944.

† Engineer, Mapping Section, Little Rock Engineer District.

Preliminary scale restitution studies were made of the negative using railroad alignments, highway tangents, section lines, etc. The usable area was then enlarged on double-weight, semi-matte photographic paper (P.M.C. No. 9) to the scale required for the detailed survey. The approximate scale of the negative being known from the scale restitution studies, the amount of enlargement was figured. The photograph negatives were at a scale of approximately 1 : 20,000 and they were enlarged to a scale of 1 : 4,800 or from 1 inch = 1,667 feet to 1 inch = 400 feet. The enlarged photograph was then used as a planetable base sheet.

Field Surveys.—The first field operation was to make a scale check of the enlarged photograph sheet. This was done by selecting two distinct points on the sheet that were at least one-half of the sheet length apart, measuring that distance on the ground and then comparing the measured distance with the scaled distance. Two or more of these scale checks were made in different portions of the sheet and a mean scale taken as the actual mapping scale. Special proportional scales for the nearest five feet of the determined scale were furnished to the topographer for plotting stadia distances. If a mean scale check of the photograph was found to be 1 inch = 408 feet, a scale of 1 inch = 410 feet was used and the topographer made allowances for the differences in the plotting and the determined scales by using the proportional scales. It was not necessary for the topographer to locate any of the topography by instrument methods, but he simply outlined in pencil the fences, section corners, houses, woods, pasture areas, and crops. He also made special notes in regard to houses, wells, power lines, road classifications, and other data that might have a bearing on construction operations. The addition of the critical elevations that could not be identified in position was the only plotting or location work required since the enlarged photograph furnished the topographic data.

Drafting.—When the surveys were completed, the enlarged photograph was inked with waterproof ink by a draftsman. The inked sheet was compared with a contact print of the aerial photograph to see that none of the topographic features had been omitted, since the enlargement might not be as sharp as the original photograph.

Bleaching.—The inked photograph was converted to a line map by bleaching out the photographic emulsion. The bleaching solution was composed of 1 ounce of potassium ferricyanide and 4 ounces of sodium hyposulphite added to a quart of water. The bleach was made permanent by washing the sheet in regular photographer's hypo solution. There are other bleaches that may be used with equal success such as iodine or a mixture of potassium chlorate, sulphuric acid, and water. It was not necessary to ink the sheets before bleaching, as pencil lines will remain after the bleaching process. The resulting line map was next

dried and a standard sheet outline mask and a title block, containing a graphic scale to correspond to the determined scale, were taped to the map.

Reproduction.—The line map was photographed and the resulting film negative opaqued to remove small flaws that may have been left on the map in the bleaching process. If the scale of the original map was not the standard scale desired, an enlargement or reduction to exact standard scale was made. Any number of copies of the positive type of reproduction could then be reproduced directly from the final film negative.

Accuracy of Method

The accuracy of the maps made by this method has been thoroughly tested in that they were used in the actual construction of the auxiliary airfields and were found to meet all the requirements of a detailed map. It should be mentioned, however, that the sites were in flat areas and no notable distortions occurred in the scale of the photograph due to differences in elevation as was shown by the very even scale checks. The method naturally works better in the mapping of flat delta lands for which the ratioing of individual photographs is not necessary.

Tests failed to show changes in scale of the paper sheet due to the bleaching process. Minor changes in the sheet length (about the same as for heavy detail paper) were noted with changes of atmospheric conditions while working with the sheet in the field. The outstanding feature of the method in regard to accuracy was the detail obtained. A topographer will not get the details on "white sheet planetable" mapping that an aerial photograph will help to portray, no matter how careful he may be with his work.

The practice of bleaching aerial photographs is not new since it has been mentioned in Army Training Manuals, but it is believed that its application to this type of detail mapping is not practiced. This article is written with the hope that greater developments may be had by its use. This office has completed some successful survey report-mapping using, instead of a single enlarged aerial photograph, a photograph of a controlled mosaic. The writer visualizes the possibility of postwar mapping of relatively flat areas for survey report-studies being accomplished in the following manner:

a. Establish base horizontal control for controlled mosaic using the Army's M-1, Land Odograph Instrument.[1]

b. Use "Precision Altimetry" method of Professor Kissam to add contouring to the controlled mosaic.[2]

c. Apply the principle described above to obtain a finished map.

[1] See Surveying and Mapping, July 1945.

[2] See Surveying and Mapping, January 1945.

Property Surveys Division

EDITOR'S NOTE.—The material for this issue of the Property Surveys Division has been assembled by C. E. Hanson, Associate Editor of the Division.

OFFICERS AND COMMITTEE CHAIRMEN, 1945–1946

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TECHNICAL STANDARDS	WM. C. WATTLES, 433 S. Spring St., Los Angeles, Calif.

COMMITTEE ACTIVITIES

Mr. S. A. Bauer reports that a final draft to the "Standards of Practice" is being prepared by Mr. Wm. C. Wattles and will be presented to the Division in the near future for comment and approval.

Mr. E. H. Owens has been engaged in working out a procedure for printing and distributing to the members pronouncements relating to the property surveying profession. Matters on newly developed surveying methods, legal matters, standards of practice, titles and location, pertinent engineering features of deed descriptions, etc., will be included in the pronouncements. The success of this idea depends largely on the participation and support given it by the members.

A LAYMAN WRITES A DEED

The following description was recently submitted to a Title Company, with request for a policy thereon:

"Lot 55 in Tract 5148, Sheet 3, at 104–77 Maps. Except that portion of lot 55 described in that certain agreement dated 9/19/44 between John McGillivray and Ralph E. Hodges, and Winifred T. Hodges granting said John McGillivray a right-of-way over said lot 55, described as follows:

Beginning at the end of Bartlett Lane near the N.W. corner of lot 55 a strip 20 feet wide Sly. along Wly. border of lot 55 to a point not more than 150 feet Nly. from the SWly. corner of lot 55 (not more than 100 feet from said corner if practicable) thence Ely. and Sly. on a feasable upgrade to a point on the Sly. boundary of said lot 55 by the shortest practicable curved route cutting off the least possible area from that corner of lot 55 and excepting the corner cut off."

This is a fantastic sample of the layman's idea of a locatable description for record purposes.

How would you plat it without a survey personally directed by the originator? At least he is definitely concerned with lot 55; he mentions it eight times, and names no other lot.

—Wm. C. Wattles

WHY INTERPOLATE?

"Natural Sines and Cosines to Eight Decimal Places" (single seconds) is the title of Special Publication No. 231, U. S. Coast and Geodetic Survey. Copies may be obtained from the Superintendent of Documents, Washington 25, D. C.—price $2.00.

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Geographical Jolts

Our grade school geographies left many of us with a lot of distorted mental images of the earth. Here's a little illusion shattering:

Vladivostok, Siberia, is farther *south* than Venice, Italy!

Houston, Texas, is closer to New York City than to San Francisco!

Santiago, Chile, on the *west* coast of South America, is actually farther east than New York City!

Texarkana, Texas, is closer to Chicago, Illinois, than to El Paso, Texas!

The Panama Canal is farther *east* than Miami, Florida!

Pensacola, Florida, is farther *west* than Indianapolis, Indiana!

If you drew a perpendicular bisecting line through the exact center of the United States you would find Tulsa, Oklahoma, in the *eastern* half!—*The Washington Star,* September 9, 1945.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

PROGRESS OF THE GEODETIC AND TOPOGRAPHIC WORK IN MEXICO. Manuel Medina, *Transactions, American Geophysical Union*, 1944.

THE ZENITH CAMERA FOR GEOGRAPHIC LOCATION. Julius L. Speert, *Transactions, American Geophysical Union*, 1944. (Describes principle and method of obtaining geographic position of a point by photographing the stars in the vicinity of the zenith. Latitude accuracy—2 to 3 seconds of arc; longitude accuracy—a function of precise timing.)

RECENT PROGRESS IN GEODETIC SURVEYS OF THE UNITED STATES COAST AND GEODETIC SURVEY. H. W. Hemple, *Transactions, American Geophysical Union*, 1944.

RAPID METHODS FOR DETERMINING ASTRONOMICAL AZIMUTHS. C. A. Whitten, *Transactions, American Geophysical Union*, 1944. (Describes a tabular and a graphical method developed by the Coast and Geodetic Survey for the Armed Forces. Tabular method gives azimuths to nearest minute of arc, and graphical method to 10 to 15 minutes of arc.)

A PLANE MAP FROM A SPHERE BY DOUBLE PROJECTION. Austin E. Jones, *Transactions, American Geophysical Union*, 1944.

NEED FOR BROAD TRAINING INDICATED BY UNIVERSITY OF NEBRASKA QUESTIONNAIRE. Roy M. Green, *Civil Engineering*, February 1945. (Gives results of a poll conducted, by the Head of the Civil Engineering Department at the University of Nebraska, among engineers and men dealing with engineers in a professional capacity.)

AZIMUTHAL EQUIDISTANT PROJECTION OF THE SPHERE. A. D. Bradley, *The American Mathematical Monthly*, March 1945. (Presents a new method of constructing an azimuthal equidistant projection which reduces the amount of computation.)

MACHINE COMPUTATION OF GEODETIC POSITION. R. M. Wilson and Irene Hess, *Photogrammetric Engineering*, March 1945. (Presents a new arrangement for determining differences of latitude and longitude, over a line of given azimuth and distance. Develops the computation for calculating machines, and for distances expressed in feet. Includes special tables for use in latitudes covered by the United States.)

DISTANCE COMPUTER. Henry H. Silverstein, *Photogrammetric Engineering*, March 1945. (Presents a graphic method for determining the great circle distance between two points on or near the surface of the earth, having given the latitudes and longitudes of the points.)

OREGON USES LAMBERT CONFORMAL CONIC PROJECTION IN HIGHWAY SURVEYS. C. B. McCullough and H. G. Smith, *Civil Engineering*, May 1945. (Describes the principles underlying the State Coordinate System, devised by the U. S. Coast and Geodetic Survey for Oregon, and its application in highway surveys.)

CARTOGRAPHY. A. K. Lobeck, *The Scientific Monthly*, June 1945. (Discusses the various contributions to cartography from the standpoint of large-scale original surveys, small-scale compilations, and world maps and globes.)

NEW MILITARY SURVEYING EQUIPMENT. William S. Little, *Civil Engineering*, June 1945. (Reprinted in this issue.)

PHYSIOGRAPHIC DIVISIONS OF THE COLUMBIA INTERMONTANE PROVINCE. Otis W. Freeman, J. D. Forrester, and R. L. Lupher, *Annals of the Association of American Geographers*, June 1945. (Discusses the need for revision of the names and boundaries of the physiographic region that lies between the Cascade Mountains and the northern and central Rocky Mountains.)

AN IMPROVED MAGNETOMETER. W. Sucksmith, *Journal of Scientific Instruments*, July 1945. (Describes the magnetometer made from new anisotropic magnetic materials to produce greater improved damping.)

THE CADASTRAL SURVEY OF EGYPT, 1879–1907. Ernest M. Dowson and V. L. O. Sheppard, *Empire Survey Review*, July 1945.

THE POST-WAR PROGRAMME OF THE ORDNANCE SURVEY OF GREAT BRITAIN. Major-General G. Cheetham, *Empire Survey Review*, July 1945. (Recommendations of the committee appointed to investigate the activities of the Ordnance Survey, with reference to the reviewing of scales and styles of Ordnance Survey maps.)

NEW METHOD OF COMPENSATING MIRROR TILT IN PENDULUM ASTROLABE. William S. Little, *Civil Engineering*, July 1945.

PROFILES OF THE ALEUTIAN TRENCH. H. W. Murray, *Bulletin of the Geological Society of America*, July 1945. (Presents 6,200 statute miles of profiles of the trench from sounding data obtained by the Coast and Geodetic Survey. Includes contoured sketch of the trench.)

A NEW METHOD OF MAKING MAPS. Chas. H. Davey, *North Carolina Engineer*, July–August 1945. (A discussion of mapping with the Multiplex Aero-Projector.)

TRIANGULATION-DATUMS IN ALASKA. A. C. Poling, *Transactions, American Geophysical Union*, August 1945. (Enumerates the datums used in Alaska, by the U. S. Coast and Geodetic Survey, and how they were connected to the North American datum of 1927. Discusses theoretical problems encountered and the conditions under which the observations were made.)

GURLEY FOUR-INCH ARMY THEODOLITE. Harold R. Larsen, *Transactions, American Geophysical Union*, August 1945. (A complete description of the optical-reading theodolite developed for military purposes by W. and L. E. Gurley. A comparison is made of the most important features of this theodolite and the Wild, Tavistock, and Parkhurst theodolites.)

AN ENGLISH PICTURE OF THE UNITED STATES. William Laas, *The Scientific Monthly*, August 1945. (Describes the British Ministry of Information Map of the United States, and points out some of the pitfalls that the maker of maps is apt to encounter when using the general purpose maps of a country with which he is not familiar.)

FEDERAL MULTIPLE-PURPOSE PROJECTS (Part 1). Alfred R. Golzé, *Civil Engineering*, August 1945. (Describes the interrelation of three federal agencies in the construction of multiple-purpose hydro projects.)

AERIAL MAPPING FOR INVASION. *Air Force*, September 1945. (Describes the twelve steps in the pre-invasion photo mapping of Leyte. A photograph of each step is also included.)

THE NEW GEOGRAPHY. Isaiah Bowman, *The Journal of Geography*, September 1945. (Thoughts on the relation of geography to human science.)

BOOKS

HISTORY OF PHOTOGRAPHY. Josef Maria Eder. *Columbia University Press.* 860 pages. $10.00.

SCIENTIFIC SOCIETIES IN THE UNITED STATES. Ralph S. Bates. *John Wiley & Sons*, New York. 1945. 246 pages. $3.50. (A survey of the evolution of American scientific societies during the past two and a half centuries covering national, state, and local organizations.)

SEEING IT THROUGH. *Bausch & Lomb Optical Company*, Rochester, N. Y. 1945. 56 pages. (A profusely illustrated pamphlet of activities of Bausch and Lomb in production of lenses and equipment for use in the various activities of the Armed Forces.)

MAPS AND SURVEYS. Arthur R. Hinks. *The Macmillan Company*, New York. Fifth edition. 308 pages. $3.75. (The fifth edition of this well known work contains a new chapter on "Further Additions" which considers the new maps required in modern long distance flights.)

BOOKS RECEIVED

REVISED GEOMETRY OF THE AERIAL PHOTOGRAPH. Earl Church, *Syracuse University*, Syracuse, New York. 1945. 56 pages. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

DISTINCTIVE RECENT MAPS

Since the last installment of these notes was prepared security restrictions have been lifted from the distribution of thousands of maps by government agencies, and the cartographic deluge that has poured into the map room of the American Geo-

graphical Society presents an embarrassment of riches. The best that we can do in a limited space is to select a few samples of distinctive map publications of highly diverse types.

Attention is first called to the increasingly large scales on which certain especially critical areas in the United States are being mapped. The standard topographic sheets of the U. S. Geological Survey are being superseded in a good many places by splendid new maps on the scale of 2 inches to the mile. A new departure, also, in geologic maps of the U. S. Geological Survey is a "Geologic Map of Santa Maria District, Santa Barbara County, California," on the scale of 1:24,000 (1944)—a preliminary map prepared in connection with oil and gas investigations on which sedimentary rocks, geologic boundaries, details of faults, existing oil wells and borings, and other features are overprinted in black on a base that is a direct reproduction of air photograph mosaics. The Mississippi River Commission (U. S. Army Engineers) is mapping the lower Mississippi and certain of its tributaries on the scale of 1: 20,000, the maps forming two series, "Hydrographic Surveys" and "River and Levee Charts," printed in black and white and issued in paper-bound volumes. The State of Texas has undertaken, through its Reclamation Department (formerly the General Land Office), the mapping of certain river flood plains and the immediately adjacent areas on the scale of 1: 24,000 with 1-foot contours in a series of which some 200 sheets have been issued in blue print.

The Mississippi River Commission has also issued (1944) a second edition of "Navigation Maps of the Gulf Intracoastal Waterways," on the scale of 1: 62,500, in a paper-bound volume; a 12-sheet map (1941) on the same scale and with 5-foot contours of "Lower Mississippi Stream Channels," from Cairo to the Gulf (of particular interest because it is compiled from surveys made in 1930–1932 and again in 1940–1941 and shows in separate colors the stream channels as of those dates); and a two-sheet map (1939) on the scale of 1: 500,000 of the "Alluvial Valley of the Mississippi River," from the mouth of the Ohio to the Gulf, showing by color overprints timbered areas, alluvial valley, existing and contemplated project levees, and overflow, backwater, and headwater areas as of 1937.

The Deprtment of Mines and Resources of the Canadian Government has issued (1945) a "Geological Map of the Dominion of Canada" on the scale of 60 miles to the inch (1: 3,801,600). Age of rocks, through the Oligocene only, is shown by colors in two categories—sedimentary and volcanic rocks and intrusive rocks. The Pleistocene will be supplied on the "Glacial Map of North America" on the scale of 72 miles to the inch, compiled by the Committee on the Glacial Map of North America of the National Research Council and now in process of reproduction by the Geological Society of America.

Professor A. K. Lobeck, of Columbia University, has issued another in his series of physiographic diagrams—a "Physiographic Diagram of Asia" on the scale of 1: 20,000,000, with accompanying descriptive text, published by The Geographical Press, Columbia University, New York, 1945. Land forms are shown in beautifully executed detail, and on the reverse side is a map on the same scale showing physiographic provinces. "Physiographic Diagram of Eurasia" might be a more appropriate title, since the maps also cover Europe.

Reference may also be made to a second edition (December 1944) of the "Symbol Book" of the U. S. Army Map Service, to be used on large-scale maps of foreign areas on reproduction scales up to and including 1: 125,000.

—JOHN K. WRIGHT

Book Review

THE STATE COORDINATE SYSTEMS: A MANUAL FOR SURVEYORS (Special Publication No. 235, U. S. Coast and Geodetic Survey). Hugh C. Mitchell and Lansing G. Simmons. *U. S. Government Printing Office,* Washington, D. C. 1945. 62 pages. $0.25.

Reviewed by S. A. Bauer, Registered Civil Engineer and Surveyor;
Chairman, Property Surveys Division, ACSM

THIS PUBLICATION marks a forward step in the direction of co-ordination between the activities of the United States Coast and Geodetic Survey and those of the practicing property or land surveyor.

The publication is an exposition of State Plane Coordinate Systems in terms of, and in relation to, the property surveyor. Only so much theory and mathematics of projections and geodesy are developed as are necessary for use by the practicing surveyor. It is to be hoped that this publication is the beginning of a series correlating the work of the United States Coast and Geodetic Survey with that of other branches of surveying.

The surveying profession has long suffered from disunity within its ranks. The geodetic surveyor, the topographer, the land surveyor—each operates within his own field, isolated and aloof from his colleagues in other specialties of surveying and often in his own. The profession, therefore, never has had the influence that other better integrated professions enjoy. The profession has not properly advanced itself technologically because of the lack of mutual aid between its members. The American Congress on Surveying and Mapping would do well to make every effort to encourage such combined activities within the profession.

In general, Special Publication No. 235 attempts to explain to the practicing surveyor, in his own language, the way in which he can profitably use the rapidly expanding system of state coordinates. The publication treats of map projections and controlled systems in their simpler terms, outlining the advantages of a co-ordinated control system by means of problems, examples, and diagrams. The publication develops formulas for conversion of geodetic control to the use of the land surveyor, continuing through a hypothetical problem to the use of a state coordinate system by a practicing surveyor in the pursuit of his profession. The publication contains several tables of value in the reduction of field observations for temperature, slope, sea level factor, etc.

It is interesting to note that the pamphlet recommends the use of azimuth rather than bearings for the indication of angles and direction. The property surveyor would do well to give the azimuth method of indication a thorough trial in calculations. He will be pleased to discover the greater simplicity of calculating angles and directions from azimuths as against the more prevalently used method of bearings. (The publication should, but omits to, make reference to the U.S.C. & G.S. very excellent Special Publication No. 231, "Natural Sines and Cosines to Eight Decimal Places," without which calculations by azimuth would be difficult. This latter publication is one of the very few tables of trigono-

metric functions set up for the calculation of traverses by azimuth as well as bearing.)

This reviewer wishes to differ with the authors on the "necessity" for measurements by the slope method for a proper accuracy, rather than by the horizontal tape method more generally used by the practicing surveyor (p. 28). The objection is on two counts: First, in the writer's experience, position closures of from 1:10,000 to 1: 15,000 are readily and economically obtainable by relatively rapid horizontal taping, requiring only reasonable care by two properly trained field men. Second, and more important, the procedure recommended in the publication is too radically different from that ordinarily used by the practicing surveyor. If co-ordination between the practicing surveyor and the geodetic surveyor is to become an actuality, proposals affecting methods and procedures of the land surveyor must be made with a careful understanding of the nature of the profession itself, its wide diversity of method, law, and custom, as well as the conditions and equipment that the economics of the profession force upon the land surveyor.

The goal—co-ordination between the land surveyor and the geodetic surveyor—is the matter of importance. This writer's knowledge of his profession leads him to urge that, in any program of co-ordination, it is essential that methods and procedures be developed that can be fitted into the fixed conditions that surround the land surveyor. The particular point chosen here for discussion is of relative unimportance to the general thought that the property surveyor does not necessarily work to 1: 10,000 as against the U.S.C. & G.S. of 1: 35,000 merely because he is sloppy or incompetent, but rather because a complex combination of factors develop (within limits) his accuracy for him. Those factors must be considered in the over-all problem of co-ordination.

It is the hope of this reviewer that the Coast and Geodetic Survey will continue to produce publications of the type of this one. Land surveyors throughout the country will benefit by a careful study of this document, and by the adoption of its principles to their individual practices.

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Map Making in the Junior High Schools

. . . We feel that this map making elective has made very definite and permanent contributions to the development of the children, to the school, and to the community. It has awakened an interest in the importance and uses of maps; it has helped to develop a precision skill; it has encouraged supplementary reading; it has provided a satisfying outlet for individual interests.—Margaret S. Chew in "Map Making as a Junior High Elective," *The Journal of Geography*, March 1945.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

THE ELUSIVE "FIXED LINE"

W. S. DIX.*—The "Problem for Land Surveyors," so interestingly presented by Property Surveys Division in the July 1945 issue of SURVEYING AND MAPPING, causes me to muse, as have many expressions of experience appearing in our Journal, how so closely we are brothers under the skin—the surveyor, the mapper, the engineer, the geodetic scientist—all in pursuit of that elusive "fixed line."

The plus, the minus, the excess, the deficiency, the hiatus, the gore, the encroachment, the accrual of error, the closure—be what it may—the trials and tribulations are common to all of us.

Aside from the property surveyor's headache—when physical facts are adjudged legal falsehoods and actual mistakes become lawful truths—surveying is continuously beset with other headaches, the physical things that concern the establishing of "known lines." The "known line" and "known point," by the way, besides being basically important to surveying, are also very elusive.

The simplest transit sight or the most elaborate astronomic observation depends upon the same basic "line" for resultant accuracy—the line called *vertical* which we all determine familiarly by "plumb bob," "level bubble," or "mercury pool."

I muse again—how geodesy connects so closely to even the simplest surveying problems. The connection is, in case you have not already guessed it, the surveyor's basic tools—the plumb bob and the level bubble. These form our link to the *vertical* or, as some of you call it, the *plumb line*. This line, whether measured directly by plumb bob or horizontally by level bubble, depends upon the pull of gravity for its determination. But, sad to relate, this pull of gravity is not directionally constant as we move from place to place and, therefore, instrument set-ups are not consistently related to each other. Each individual set-up is based on its individual vertical or plumb line rather than on a common "known line." Sometimes this deflection from a common vertical is slight, sometimes alarmingly great. In Puerto Rico, for instance, the Coast and Geodetic

* Cartographic Engineer, Tennessee Valley Authority, and Registered Surveyor and Engineer, State of Ohio.

Survey recorded a difference of nearly a mile in length between two astronomically observed and computed positions, and the same points measured by geodetic triangulations.

Is it any wonder then, that headaches are so many times involved in closing or joining surveys, especially where systems of geodetic surveys are not available for basic connection?

Since it is the function of the geodetic survey to aid the surveyor combat these "gremlins" of the level and plumb line, and also the "gremlins" of the compass bearing, I make a suggestion that a few brief articles be written in the surveyor's language by geodetic experts. I believe they could be very interesting and would acquaint many surveyors with the value of geodetic surveys in his survey controlling problems.

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SIMPLICITY IN MAPS

CHARLES H. DEETZ.*—Simplicity will scarcely be denied to be the best recommendation of a map or chart, but it should be kept in mind that *simplification* and *abridgment* are by no means convertible terms. Many maps have been published, professing to simplify the elements by reducing their exposition into a compass sufficiently generalized to dissipate the alarm which is reasonably felt where unlimited content and minute detail prevail.

The proper procedure is to bring out the essential characteristics in a clear light, without entering deeply into incidental features which have no reference to the professed purpose of instruction. If it is true, as Aristotle says, that the mere chalk outline of a simple figure is more interesting than a multitude of brilliant colors or details thrown carelessly together, without regard to significant design, it is no less true in maps and charts, that pertinent objects should be boldly outlined for the rapid comprehension of the mind's eye, even at the exclusion of parts of minor importance.

We find too often a sort of patchwork composition without intelligent design, and the user of a chart *is led to fix equal attention* on all its parts, though many are superfluous, and many defective. Even where an original survey may be quite satisfactory, the final compilation of its elements, after all, is the thing where honest thought and utmost skill are of vital significance.

* Cartographic Engineer (retired), U. S. Coast and Geodetic Survey.

CONGRESS NEWS

The Editor Reminisces

(As Presented at Annual Meeting—June 23, 1945)

I HAVE always felt that an Editor's report is something of a superfluity. If the product is good then what more is there to say, and if it isn't, then no amount of alibiing will make it any better. But since the Committee on Arrangements has insisted that I make some remarks, I would like to mention a few of the less obvious things that go into the makeup of our publication.

Those of you who have done editorial work no doubt appreciate what a headache it can sometimes be. The job of blue-penciling an article is one of the most unpleasant tasks an editor has to perform. He is usually torn between two irresistible desires; a desire to hold the *status quo* of the article—which would of course be the line of least resistance—and a desire to comply with the decisions of the Publications Committee—which of course must take into account the financial resources of the organization. In effecting a balance between these two, the controlling factor is always the extent to which matter may be deleted or amended without detracting from the central theme of the article. Every article and item that appears in the magazine is given a thorough going over and this sometimes involves some very major editings.

I took over the editing of the magazine beginning with the January 1943 issue. It was then known as the "Bulletin" and was an 8-page pamphlet consisting mostly of news items. It was soon realized, however, that the Congress could not coast along for very long on that kind of a publication. The decision was therefore made to expand the "Bulletin" to include a number of signed articles together with other matters of Congress interest. In the following issue—April 1943—the Bulletin was enlarged to 20 pages. Since then each succeeding issue has been larger, and the most recent number contained 72 pages. In all, 440 pages have thus far been printed. New departments have been added to the magazine from time to time, some of the more significant ones being: Federal Surveying and Mapping Agencies, the Property Surveys Division, Congress News, Current Surveying and Mapping Literature, Book Reviews, and Comment and Discussion. The last-named department has brought forth some very constructive suggestions for the improvement of our magazine. I hope they will continue to come in.

Beginning with the July 1944 issue, the name of the publication was changed from "Bulletin of the American Congress on Surveying and Mapping" to "SURVEYING AND MAPPING."

The preparation of SURVEYING AND MAPPING for publication is not confined to editorial work alone. Involved also is the processing of material. For example, to obtain the information for current surveying and mapping literature (magazine articles and books), for possible reprints, and for "filler" items, about 30 technical magazines—domestic and foreign—must be scanned each month. The pertinent articles must be read, brief digests prepared, and the material filed for future reference. If a particularly suitable article is found arrangements must be made for its reprinting. To date, 787 issues of magazines have been scanned and 162 articles digested and listed in SURVEYING AND MAPPING, in addition to 41 books.

Then there is the matter of correspondence. This is a more formidable item than might appear on the surface. There is correspondence with the author, with the printer, with other editors, with officers of the Congress, and with the stray inquirer. Approximately 400 letters have thus far been received and an equal number sent by the Editor alone.

We have published 86 signed major articles, of which 61 were specially prepared for SURVEYING AND MAPPING, and 25 were reprints. In addition, 175 minor articles and miscellaneous items have been published. I think it is gratifying that we have been able to keep the reprinted articles to such a low percentage, considering the newness of our organization. In saying this, I do not want to appear apologetic for publishing "reprints." I make this comparison merely because it has been suggested that the Congress is resorting to "a great extent on reprints." Of course we should publish as much original material as possible, if for no other reason than to build up a prestige for our publication. It should be developed to such a point that authors will seek it out as a medium for the presentation of new ideas and new developments in their fields. But I want to emphasize that it is our own members who can help build up this prestige. In this respect I would like to appeal to those of you who may have a story, a message, a new wrinkle, an interesting surveying experience, to write it up and send it in for consideration.

As for "reprinting," our policy should remain as is, at least for the time being. We should not refrain from reprinting articles merely because they were first published elsewhere. The importance of the subject matter treated and the inaccessibility of the original source to a large portion of our membership should continue to be the criteria for future selections.

While on the subject of "reprints," and since the theme of tonight's meeting is "co-operation," I should like to take this opportunity to ex-

press appreciation, in the name of the Congress, to the Editors of The Military Engineer, of Civil Engineering, of Engineering-News Record, and of Photogrammetric Engineering, for their fine co-operation in extending to the Congress the privilege of reprinting articles from their publications, as well as for their courtesy in lending us many illustrations and "cuts." On the personal side, I want to thank Mr. C. E. Hanson, Associate Editor of the Property Surveys Division, for his co-operation in gathering material for his Division, and President Whitmore for the fine encouragement he has given me at all times.

As for the future of our publication, I believe its potentialities are great. The magazine can be improved as we go along, and doubtless it will be, but it seems to me that even in its present form—and I say this objectively—it is already filling a long-felt need in the surveying and mapping field. The fact that it is the only magazine in this country that deals exclusively with surveying and mapping matters, should of itself be an effective talking point in its promotion. We should capitalize more on this unique status. That it is beginning to be noticed by outsiders is evidenced by the fact that during the year four major publishing houses have voluntarily sent us "review copies" of new books. But we need more public relations work; there are altogether too few people who know about the Congress and its work.

Let me close this brief resume by saying that for myself there has been a certain measure of satisfaction in being associated with the publication of the magazine. Watching it grow, and helping in a small way to establish it on a sound basis, has been some compensation for the many headaches the job of being Editor has given me.

A. L. SHALOWITZ

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Prize Winners

We have just been advised of the results of the Prize Competition on "The Use of Plane Coordinates in Property Surveys," which was announced in the April 1945 issue of SURVEYING AND MAPPING. The following are the winners:

First Prize

Mr. William B. Hoke of Towson, Maryland

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Second Prize

Mr. C. A. Monroe of Manhasset, New York

Mr. Hoke's article will be published in the January 1946 issue of SURVEYING AND MAPPING, and Mr. Monroe's in a later issue. Congratulations to Messrs. Hoke and Monroe!

—THE EDITOR.

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"Surveying and Mapping" Index

A complete index of Volumes I to V inclusive of SURVEYING AND MAPPING will be published shortly as a Supplement to the October 1945 issue.

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That the American Congress on Surveying and Mapping *is organized to . . .*

- ADVANCE the sciences of surveying and mapping in their several branches, in furtherance of the public welfare and in the interests of both those who use maps and surveys and those who make them, and to establish a central source of reference and union for its members.

- CONTRIBUTE to public education in the use of maps.

- ENCOURAGE the prosecution of basic mapping programs which are paid in whole or in part with public funds.

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